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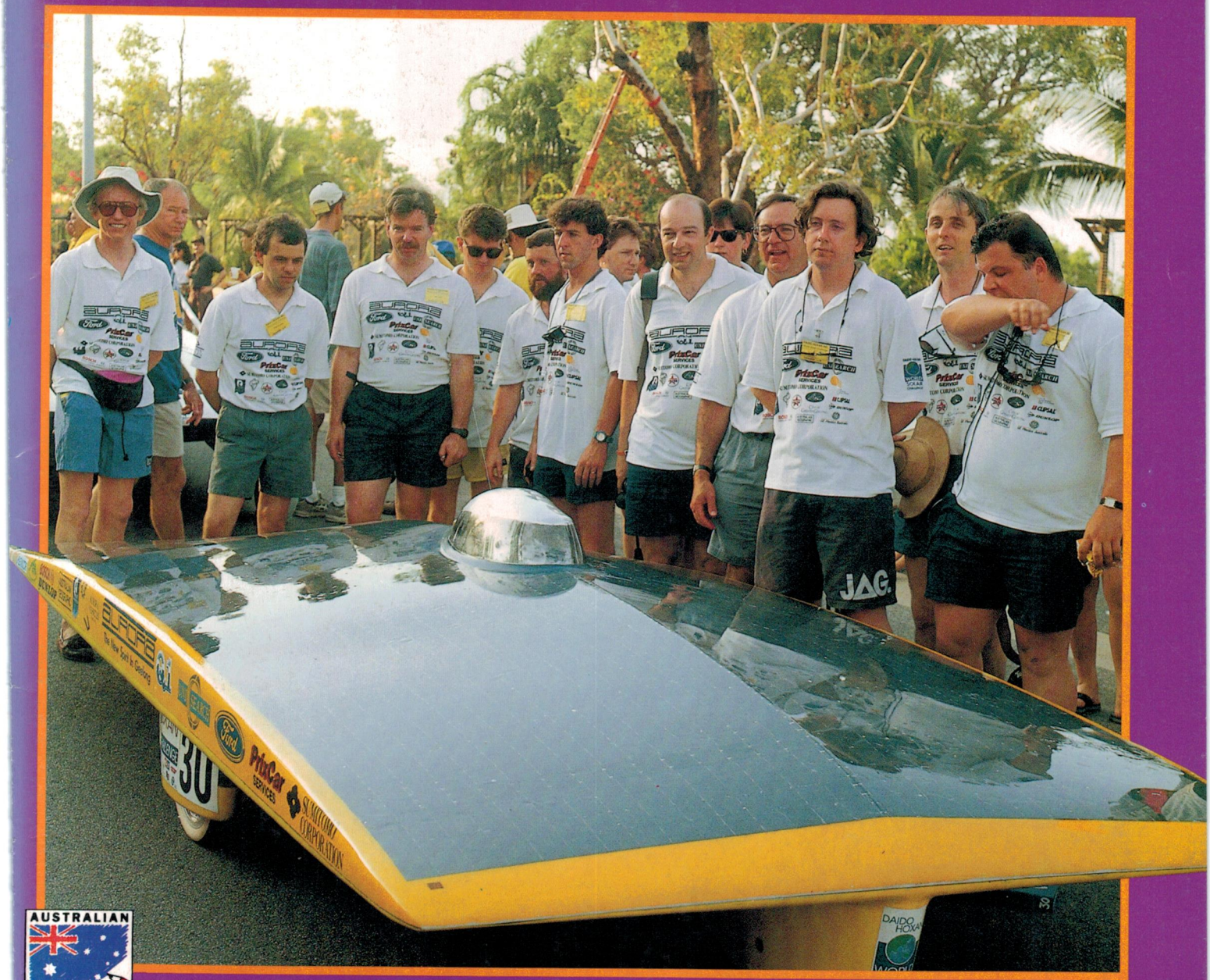

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The Micron Sure Shot is quickly taking Australia by storm. Here are some user comments:

"I am very impressed with the T 1270 de-soldering tool. It makes de-soldering easier than soldering." Brett Smith, Brett Smith Technologies Pty. Ltd. QLD

"For the Price and what it can do it is the best de-soldering tool on the market." Adrian Michell, Television Replacements. VIC.

"We found the Micron de-soldering gun a must to have. The unit is easy to handle and the de-soldering action is very fast." Robert Benden, Qualitec. NSW.

"Comparing the performance and price with other brands, it is very good value for money. The carry case makes it handy for the tradesman on the move." Trevor Hewitt, Electro-Acoustics. WA

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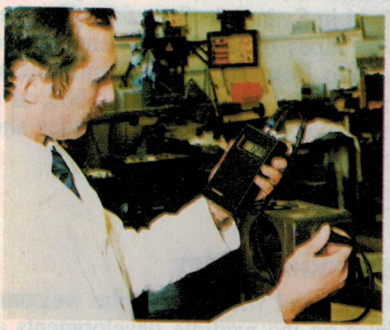
Electronics AUSTRALIA WITH ETI

Volume 56, No.2
February 1994

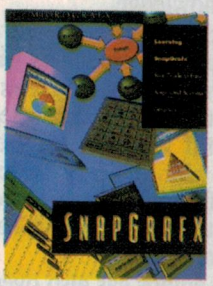
AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE — ESTABLISHED IN 1922

Ultrasonic thickness gauge



A firm in the UK has developed this handheld ultrasonic digital thickness gauge, capable of measuring the thickness of metals, plastics and glass to within 0.01mm. For more details see page 102...

New feature: Spotlight on Software



This month we're starting a new feature, to provide regular reviews of computer software. It's called Spotlight on Software, and to launch it we're looking at Micrografx's 'SnapGrafx' — a handy new package for cranking out business diagrams and tables. See page 124.

On the cover

Before the start of the 1993 World Solar Challenge, the team of Australia's entry 'Aurora Q1' gather around their car. They did extremely well indeed, finishing in fifth place. See our features on the WSC, on pages 18-26. (Cover picture taken by David Jeanes.)

Video and Audio

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Projects and Technical

Professional Electronics

Columns and Comments

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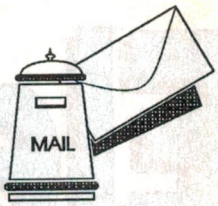
LETTERS TO THE EDITOR



SETI/HRMA project

In the very week that you featured an informative article on NASA's search for life in the Cosmos, the United States Congress axed this US$12million/pa program, to use radio telescopes around the world and in Australia to detect signals from intragalactic civilisations. Meanwhile, the Planetary Society's Project META continues as the only ongoing, operational sophisticated search from both hemispheres. Indeed in the same week, the Society sponsored three public seminars in Eastern Australia to discuss findings to date.

The Society, as the world's largest space advocacy organisation, with over 1000 members in Australia alone, relies on private donations and support to keep up its own Search for Extra-Terrestrial Intelligence (SETI), which will soon expand into Project BETA — a billion channel analysis of signals issuing from the Cosmos. While NASA's search has had a chequered history of support, META just gets BETA!

Here in Australia, political support for SETI is evident. While the Minister for Science and Small Business declined to comment, the Shadow Minister for Science, Technology and Export Development, Dr David Kemp in a congratulatory letter to the Society indicated his interest in SETI which 'is one way in which we expand the boundaries of our experience'.

Dr Kemp further stated that the 'Federal Coalition is deeply committed to Australian science' and wished ' all those involved in SETI the very best of luck'. Some two hundred interested scientists, educators and members of the public attended the Society's seminars arranged in Canberra, Melbourne and Sydney, which resulted in lengthy newspaper articles in each city's press plus television coverage.

NASA Senior Representative in Australia, Ted Ankrum summarised the SETI budgetary situation as not completely lost. He is negotiating for the transfer of HRMS terminating expenses to enable the CSIRO to complete its development of local SETI equipment and proceed with observations using private funding support.

Most of the $0.4 million of hardware is in place to enable a semblance of Australia's $1.7 million part of the program to proceed, with money and lobbying from organisations such as the Planetary Society and the SETI Institute, both like NASA based in the United States.

A further SETI seminar will probably be held in Sydney in September/October 1994. Tapes of the SETI Seminar are available from Astratech Communications, GPOB 2086, Canberra 2601, at a cost of $20 for three C90 cassettes and flyers, including postage.

Matthew L. James,
Canberra, ACT.

Australian radar

I have read with interest the welcome articles on the wartime developments at the Radiophysics Laboratory, Sydney. Unfortunately, the author's historical interpretations are sometimes simplistic. Thus he claims that the Shore Defence (ShD) project was delayed because RPL lacked a sense of urgency and 'the actual work was in the hands of young scientists, some with very little electrical knowledge...'

On the contrary, all were carefully selected honours graduates, most with Sydney University degrees in both electrical engineering and science. This fundamental training was excellent preparation for quickly reaching the frontier of the latest electronic and UHF/VHF techniques, which had far outstripped text books.

What the author has also overlooked is that they were guided and supervised by some of the top radio scientists/engineers in the country. A few of these were seconded from AWA, but most had been nurtured in advanced research with the Radio Research Board.

One was Dr Jack Piddington, who prewar in Cambridge, developed a high power pulse equipment primarily for ionospheric studies, not aircraft location. However, having divined the purpose of Watson Watt's secret group he also made some aircraft observations. Far from showing 'no interest', the RRB supported continued work on his return in late 1938. This was overtaken by Britain's disclosure of its radar secrets in early 1939, leading to the formation of RPL.

Another senior scientist, not mentioned

by the author, was Dr Joe Pawsey (the post-war 'father' of Australian radio astronomy), who, after pre-war radio research in Cambridge, developed the VHF aerials and feeders for the EMI television system. His role in ShD, particularly the RF systems, was crucial. Far from 'struggling to become RF designers', young RPL scientists were exposed to world class expertise. With such mentors in charge, who needed textbooks!

The ShD radar had several innovative features; the first gunnery trials with it in February 1941 were highly successful. Production, however, involved RPL with a network of organisations and it was then that delays occurred.

Overcoming internal and interface problems under the stresses of war was no easy task, but that is another story. The point here is that RPL accomplished the R&D for Australia's first operational radar in a commendably short time, and to this result the younger staff made a vital contribution.

H.C. Minnett,
Castle Cove, NSW.
(Chief of CSIRO
Radiophysics Division, 1978-81).

PC power supplies

Lately I've been asked to repair several switchmode power supplies from personal computers, and have been something between amazed and disgusted at the total lack of servicing information on these devices.

The attitude throughout the whole PC 'industry' is that if such a unit fails, simply 'replace it', without even attempting to find the problem — which is commonly nothing more than a 16¢ high speed rectifier diode having give up the ghost. This can be easily identified.

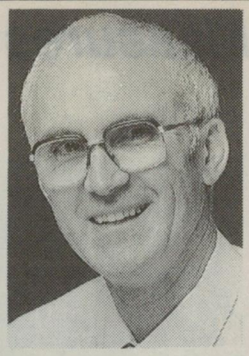
I recognise that the reasoning behind this attitude is simply that 'on average it will be cheaper to replace the power supply than pay a technician to find and correct the fault'. But I for one have no wish to see the tips filling up with electronic equipment suffering only minor faults, or for technicians to be reduced to 'module jockeys'.

PS: Does anyone out there have a circuit for a Hewlett Packard 20C/25C RS Vectra computer power supply?

Bob Parker,
Carlton, NSW.

Letters published in this column express the opinions of the correspondents concerned, and do not necessarily reflect the opinions or policies of the staff or publisher of Electronics Australia. We reserve the right to edit letters which are very long or potentially defamatory.

EDITORIAL VIEWPOINT



The 'black box syndrome': an international problem

A recent issue of *New Scientist* carried a very interesting story from that magazine's Tokyo correspondent, reporting on a 'White Paper' which has been released by Japan's Science and Technology Agency (STA). The paper concerned arose from a study by the STA into a problem which sounds familiar: since the late 1980's, the proportion of Japanese school leavers applying to study science and engineering at university has been falling. There's also been a decline in the number of people in their twenties who admit to an interest in science.

In the White Paper, the STA attributes these trends to what it calls the 'black box syndrome' — the fact that so much of the latest hi-tech equipment is effectively a sealed and inscrutable module, which gives no clue as to how it's made or how it works. As a result, they suggest, young people no longer have any easy way to find out 'what's inside', and perhaps be encouraged to try building things for themselves. They suggest that this in turn breeds a 'passive user' approach to science and technology, rather than fostering curiosity and a desire for active involvement.

This drift of young people's interest away from science and engineering is by no means unique to Japan, of course — most of the world's developed countries seem to have been reporting it. So it's very much an international problem, and one which doesn't augur at all well for the future of science-based industries like electronics.

I suspect the 'black box syndrome' identified by the STA is at least one contributor to the problem. When I was a kid, there were plenty of old valve radios we could open up to investigate the 'works', and then pull them apart to get bits for making things of our own. The first audio amplifier I built was made from old radio parts, for example, and when I built my first TV set (from a design in this magazine!), it too contained a lot of parts from old radios. It was all good fun, and no doubt contributed to an enduring fascination with the technology and the science behind it.

Nowadays, though, the trend to automated assembly, surface-mount technology and VLSI has made it almost impossible for today's young people to get this kind of 'hands on' experience and motivation. In fact many of the latest consumer products seem designed deliberately to discourage *anyone* from even opening the case, and many experienced service technicians can be nervous about doing so — let alone trying to remove and replace miniature SMD parts or inscrutable VLSI chips.

We certainly seem to be heading inexorably towards that long predicted 'non-repairable, use it and throw it away' level of technology, even though it has serious implications for our environment as well as the future of technology itself...

What's the solution to this problem? Well, here at *EA* we try to do *our* bit by describing at least a certain number of projects for beginners, using low cost, easy to handle and readily available discrete components. Our only trouble with this is that when we do, we often get criticised by the more advanced readers — saying that we're teaching kids about 'ancient' technology, and not providing enough help for everyone to keep up to date with the latest gee-whizz stuff!

Jim Rowe

Measures temperature, wind speed, direction etc:

The Ultimeter II Home Weather Station

Now available in Australia through Paris Radio Electronics, the Ultimeter II Home Weather Station offers a low cost, reliable system for convenient measurement of wind speed and direction, and temperature. A rain gauge accessory option is available, as also is an interface so the station can be linked to a personal computer for data logging, etc.

by JIM ROWE

An accurate knowledge of local weather conditions can be very useful, for many occupations and activities including aircraft and glider pilots, crop sprayers, fishing boat operators, recreational mariners, farmers and graziers, orchardists and of course amateur meteorologists. This being the case, the new Ultimeter II Weather Station should be of considerable interest.

Made by the Peet Brothers Company, of West Allenhurst, New Jersey (USA), the Ultimeter II is an improved version of a very successful model which has been selling in the USA and other countries since 1985. The basic system measures wind speed and direction, plus temperature; an optional accessory allows rainfall measurement as well. In addition a second option provides an RS-232C serial cable to connect the system to a personal computer, plus matching software.

There are four main components of

the basic system: a wind speed and direction sensor head, intended to be mounted outside on a suitable mast, clear of obstructions; a temperature sensor, which is also mounted outside in a suitable location (i.e., protected from direct sunlight, rain and wind); a compact display and control console, which can be placed inside at any convenient location; and a small 'plug pack' power supply.

There's also a small junction box, and of course a set of cables to connect everything up. The modules and cables use standard RJ-11 'modular' connectors, by the way — as used nowadays for telephones, and in many office PC networks.

The wind speed/direction sensor head is compact and elegant, being molded from 'Lexan' plastic which is specially formulated to give long life despite the exposure to UV radiation from the sun. The wind speed cups are moulded with short arms, which click into sockets moulded on the rotating boss; this means that in the unlikely event of a cup being hit by a flying object and broken off, a replacement can be fitted without hassle.

An ingenious 'collet and ring' system is used to simplify mounting of the head to the support mast, without any need for spanners, screwdrivers or Allen keys. The mast can be between 25mm and 32mm in diameter, and should ideally be of aluminium or other non-magnetic material.

Unlike other wind direction sensors which use a rotating wiper arm and 360° resistor element, the Ultimeter sensor uses a rotating magnet in conjunction with sealed reed switches. This means that there is no physical wear, and hence greater reliability. The wind speed (anemometer) sensor also uses a magnet and reed switch pulse generator, while both use bearings with stainless steel balls — again for longer life when exposed to the elements.

The temperature sensor uses a thermistor element, mounted inside a short stainless steel tube and again sealed to prevent the ingress of moisture.

Of course the console is the part of the system that the user sees most, and which is used to control its functions. This is very compact, measuring only 171 x 70 x 32mm, and comes with a small tilt stand for desk use.

It provides a 12-key control pad together with an LCD panel measuring 82 x 38mm, for display of the weather parameters. The wind direction is displayed on a '16-point compass rose' analog-type display area on the left-hand side of the LCD panel, about 32mm in diameter, while the other parameters are displayed in digits about 10mm high, on the right. Other icons and smaller legends are used to indicate the operating mode, measurement units, etc. A built-in backlight is provided for the LCD panel, and can be switched on when desired.

The console is based on a dedicated microprocessor, and can easily be programmed to display the measured parameters in a selection of units. For example the wind speed can be displayed in either mph, kph or knots, while the temperature can be displayed in either degrees Celsius or Fahrenheit. For good measure the unit also provides a built-in digital clock, which can be set to display in either 12-hour AM/PM format or 24-hour format; and a calendar, which can be set for either DD-MM-YY or MM-DD-YY format as desired.

If the optional rain gauge attachment is added, the console can apparently also be programmed to display rainfall in either centimetres or inches.

By the way, the inbuilt micro is designed to provide rather more stable and reliable readings of prevailing wind direction than is usually the case, by ignoring short-term swings of the vane and instead calculating and displaying a 'rolling average'. It is also programmed to 'lock' the direction display when the wind speed drops below a certain value, again to avoid giving misleading readings.

Another advantage of having an inbuilt micro is that the Ultimeter II can be calibrated quite painlessly, in terms of wind direction sensor orientation. In fact as the User Manual explains, there are actually three different options in terms of calibration procedure.

The 'point and plug' method requires the wind vane to be pointed due North, with the speed cups spinning in a real or simulated breeze of about 20kph, before the sensor cable is plugged into the console (which has previously been set to its 'calibrate' mode). The other methods are somewhat easier for a single person to perform, and involve either indoor calibration before mounting the sensor head on the mast (with a known orientation), or 'post mounting' calculation of a correction constant, from observation of the readout error. With the last method, the correction constant (a number between 0 and 255) is simply fed in via the keypad, and stored in memory.

Incidentally although the Ultimeter II system is operated from a small plug-pack supply, the console also contains a backup battery system: a small 9V alkaline battery to ensure that the information in memory is retained during power failures, etc. The battery can run the system for up to two weeks without mains power, as the average current drain is normally only 1mA (with the LCD backlight off — it rises to 75mA with the backlight on).

Yet another advantage of having an inbuilt micro is that the Ultimeter II can provided 'derived' measurement data, in addition to the primary parameters. For example it can calculate and display the wind chill temperature, from the basic temperature and wind speed readings. It can also display the maximum wind speed, together with the time and date it occurred. Similarly it can display the lowest wind chill, highest outside temperature and lowest outside temperature, and also sound an alarm if the wind speed exceeds a critical figure.

If you fit the optional rain gauge, it can also calculate the daily and monthly rainfall totals. And if you get the RS-232C serial data option as well, the system can also be set up for automatic data scanning, so that the PC software can maintain an ongoing log of the weather parameters.

Trying one out

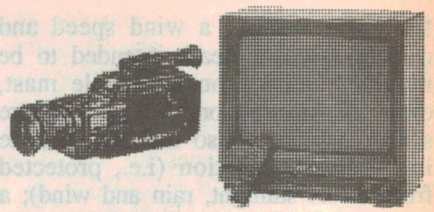
Local distributor Paris Radio Electronics made a sample Ultimeter II system available for a few days, so we could try it out for ourselves. We found it very easy to set up and get going, even though we deliberately chose the 'third method' of calibrating the wind direction sensor. Calculating the correction constant turned out to be surprisingly straightforward.

The review system was the basic version, without the optional rain gauge or computer interface, so we weren't able to try these out. However the basic setup worked very nicely, with clear and unambiguous readout of the various parameters. The User Manual is also quite helpful, explaining virtually everything you need to know.

On the whole, then, we found the Ultimeter II Home Weather Station an attractive and well-made product. For the quoted RRP of $349.00 for the basic system, it therefore seems to represent good value for money. The optional rain gauge costs a further $129.00, by the way, and this is also the cost of the optional RS-232C cable and matching computer software.

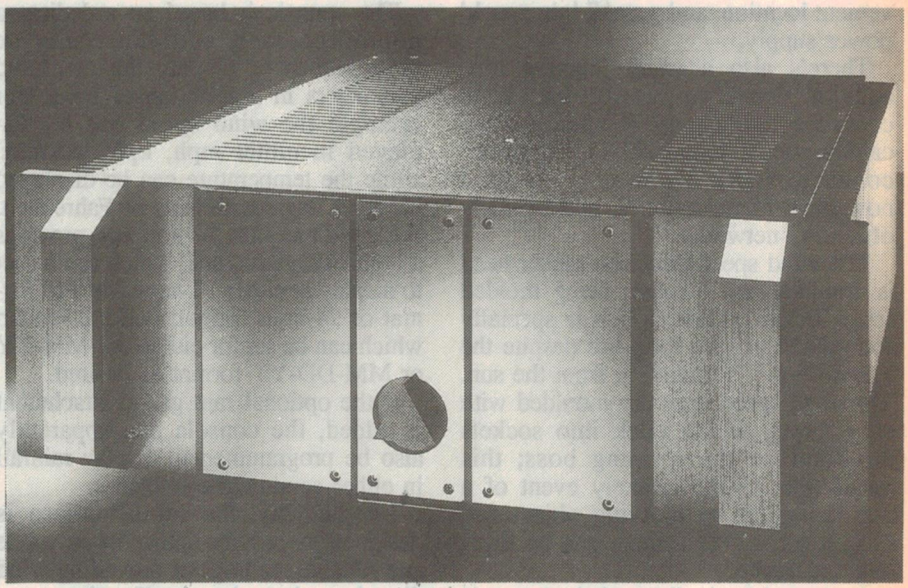
Further information is available from Paris Radio Electronics, 161 Bunnerong Road, Kingsford 2032; phone (02) 344 9111. ❖

What's New in VIDEO and AUDIO



High end amp from Denmark

Gryphon Audio Design of Denmark produces a number of quality high end pre-amps and power amps, headamps and step-up devices. The firm's latest release is the S100 stereo amplifier, which is claimed to support the same design philosophy of its predecessors: 'to amplify the input signal without colouration'. Supporting this is circuit topology which uses fully balanced discrete circuitry and true dual mono design. The AC input, On/Off switch, and a common face plate are the only cohabits; there are no other commonly shared components.



To produce its conservative 100W RMS into eight ohms and sustain peaks of 2kW into loads as low as one ohm, the power supply is supported by custom made 160,000uF capacitors. Twenty-four matched Sanken 20A output transistors provide an output impedance of less than 0.07 ohm, proving unconditional stability to any known load. To protect this powerhouse the Gryphon employs comprehensive protective circuitry which responds immediately to DC, short circuits of SOAR at the output. The output is further protected by thermal sensors in the event of overheating.

Unlike most other high end audio manufacturers Gryphon doesn't employ any bandwidth limiting, although this approach places greater challenges on designers in areas of component selection and board layout. Gryphon contend that open bandwidth topology benefits in superior performance in such crucial areas as slew rate, phase characteristics, transient response, imaging and sound stage. As a result the frequency response extends to beyond 350kHz and requires

VCR for camcorder users

Akai has announced a four head IHQ 'Moviemaker' VCR which is targetted primarily at camcorder users. The 'Moviemaker' incorporates Akai's new improved IHQ circuitry, which automatically matches recording and playback characteristics to the video tape being used. The IHQ circuitry enables users to obtain premium picture quality even from standard formulation tapes. Similarly, when using higher grade tapes picture quality is comparable to S-VHS standard.

The improved IHQ circuitry also incorporates an S-VHS tape detection switch to ensure correct matching to this premium formulation. It is however, the combined editing and camcorder features of the 'Moviemaker' that most users will find useful.

External front line-in jacks (RCA) make easy connection to camcorders or when copying from one VCR to another. The large job/shuttle knob allows the user to change playback speed (forward or reverse) by the amount, and in the direction you turn the knob — whose settings are high speed reverse, review, reverse play, reverse slow, still, slow, play, cue and high speed cue.

The jog dial also makes it possible to move the picture frame by frame in either direction. In Edit Search mode the section which has already been recorded can be checked and the recording pause position changed while in the recording pause mode. Other features include an Auto Head Cleaner which automatically cleans the head whenever a tape is loaded or unloaded.

The 'Moviemaker' is covered by a twelve month parts and labour warranty and is available at selected Akai dealers and department stores.

meticulous attention to layout and grounding patterns. An absolute minimum of wiring is employed, and what is used is newly developed Cardas cable. Signal paths are kept short by the use of extra thick copper traces, all to military spec double sided PCB.

The Gryphon S100, like other of the company's designs, employs zero negative feedback. Gryphon contends that negative feedback is a 'bandage approach' to an amplifier's ills; the more logical way is a purist approach of getting the circuit topology correct right from the beginning. Such a philosophy requires the exacting selection and matching of components; in many cases components have to be specially manufactured for Gryphon. Technical specifications include 100W RMS into eight ohms at 1kHz, 800W RMS into one ohm and peak power of 2kW into one ohm (gain 29dB); frequency response 2Hz to 350,000Hz +/-1.5dB; output impedance 0.07 ohm (2Hz to 60kHz).

The Gryphon S100 stereo power amplifier is covered by a two year parts and labour warranty and has an RRP of $11,995. For further information on this and other Gryphon products contact Kedcorp Pty Ltd, on (02) 708 4388.

20-bit effects processor

Yamaha Music Australia has released the latest generation SPX990 Digital Effect Processor, a true stereo digital effects processor employing 20-bit A/D and D/A conversion for outstanding sound quality. The SPX990 is ideal for professional applications in recording, broadcast, film and video post-production and concert sound reinforcement. A range of new effects makes the SPX990 more expressive than ever, with reverb claimed to be'totally natural', various intelligent pitch change algorithms, tempo-based delays, and more.

The SPX990 features a true two-in-two-out configuration which allows stereo sources to be processed without degrading the stereo image. All inputs and outputs are electronically balanced, with XLR and jack connections (switchable +4/-20dBm) for compatibility with the widest range of equipment.

In one convenient unit the SPX990 combines many of the signal processing functions normally performed by separate devices. In addition to 36 main effects, the SPX990 provides four pre and three post-effects. One could, for example, precede a reverb effect with a compressor, then follow it with equalisation. Main effects comprise programs for reverb, early reflections, delay and echo, modulation, pitch change, pan, freeze and multi-effects. Pre and post effects comprise parametric equalisation, compressor, harmonic driver and compressor/distortion/eq (pre only).

The unit is shipped with 80 preprogrammed effect programs, compiled by leading studio engineers from the USA, UK and Japan. Up to 100 user defined programs may be stored internally, while external memory cards can store up to 100 effect programs each.

Unique features offered by the SPX990 include tempo-based delay time programming which can define delays in terms of tempo or note length; superior pitch precision which provides faultless pitch tracing through a new dynamic waveform analysis technique; intelligent pitch change which, unlike parallel tracking, creates appropriate harmony based on a specific key and scale type; and stereo reverb, a full stereo reverb algorithm that retains the original stereo image of the input signal. For sophisticated remote control and automation capability, the SPX990 is extensively MIDI equipped. It allows MIDI selection of all programs, and real time control of up to two effect parameters simultaneously. For more information circle 181 on the reader service card or contact Yamaha Pro Digital Group, on (03) 699 2388.

CD players/receivers for cars, from Kenwood

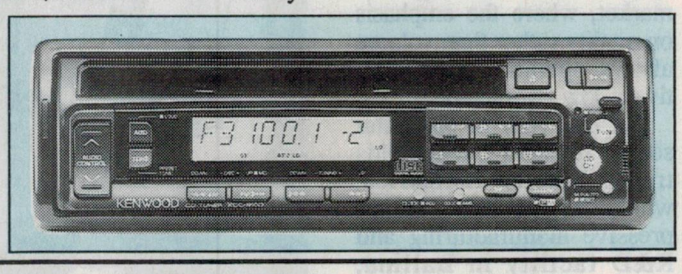
Kenwood Electronics has a new car CD player/tuner line-up, comprising the KDC-9100 CD player/tuner with changer control, and KDC-7100 and KDC-5100 CD player/receivers.

All models are designed to pick up both AM and FM stereo stations and incorporate the very latest CD player technology. Features include a 'Theft Deterrent Faceplate, and infra-red remote controllers. The Theft Deterrent Faceplate (not in the KDC-5100) can be simply removed by the driver and taken with them whenever leaving the car. Kenwood provide a TDF 'sunglass case' size carry case to protect the faceplate. All models employ four of Kenwood's latest single-bit D/A converters with eight times oversampling technology that is specially chosen for its outstanding sound quality. For easier reading the flagship 9100 model has a four way selectable liquid crystal display that offers either a choice of green/reverse, or amber/ reverse.

The flagship model KDC-9100 is designed to be configured with a CD changer, such as the KDC-C601. This configuration allows the driver or passengers to quickly identify what track and disc is playing and also to program any selection in any order. The KDC-9100 offers RCA pre-outs for front (left and right), rear (left and right) and centre. A 10-key credit card remote control allows either the driver or passengers to make selections. The KDC-9100 also provides separate bass, mid-bass and treble control with pre-set memory. The KDC-7100 and KDC-5100 both offer 25 watts/channel stereo, or can be configured for 9W x four channels, for two front and two rear. Both models use specially customised Quad single-bit D/A converters, optimised for car environments.

Similarly, Kenwood's Super Optimum Service Control circuitry minimises skipping caused by bumpy conditions or heavy terrain. Additionally, all CD player/receivers use Kenwood's Digital Pulse Axis Control (DPAC II) circuitry for jitter free operation.

The KDC-9100 has an RRP of $899, while the KDC-7100 and KDC-5100 carry RRP's of $799 and $699 respectively.



Philips slashes DCC prices

Philips has substantially reduced the prices of all its digital compact cassette DCC players and recorders, internationally. Recommended retail prices now start at $699 for the DCC130 'joggable' personal stereo portable and reach just $999 for the DCC900 top featured remote control hifi recorder/player deck. Between them is the DCC600 hifi recorder/player at only $799. When the DCC was released in Australia in March 1993, it had an RRP of $1799.

A spokesman for Philips said that these new prices bring the sound quality and display features of digital compact cassette into the same price bracket as well designed analog audio cassette decks.

Customers who had already purchased a Philips DCC player or recorder will not be ignored by Philips. If they paid the higher prices, a simple phone call to 008 803312 will register their name to receive 25 pre-recorded digital compact cassettes, with Philips' compliments. ❖

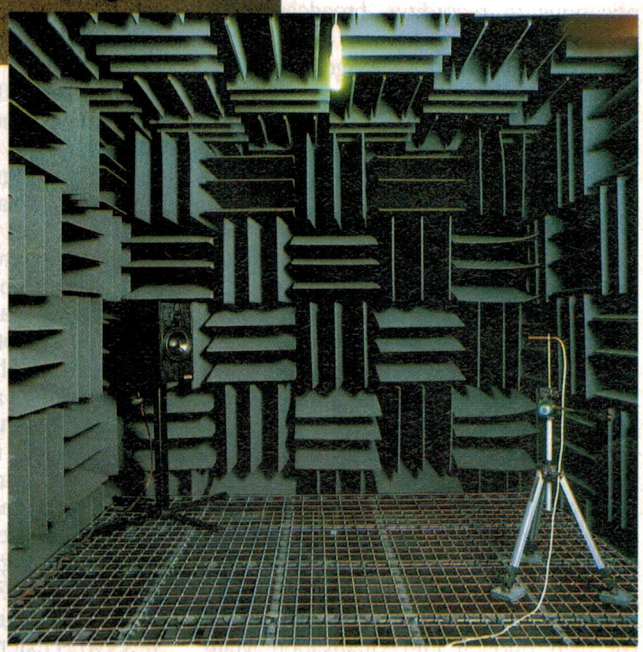
LOCAL SPEAKER FIRM INVESTS IN THE FUTURE

Whereas most of Australia's loudspeaker system manufacturers are in the small 'boutique' category, catering to the low volume high-end market, Betetec Industries chose to establish itself by manufacturing systems for well-known consumer brands. This has given the firm a good foundation for growth, and it now boasts an impressive automated manufacturing plant and R&D facility in Ballina, NSW — as well as its own brand of competitively-priced consumer speaker systems: the Aaron range.

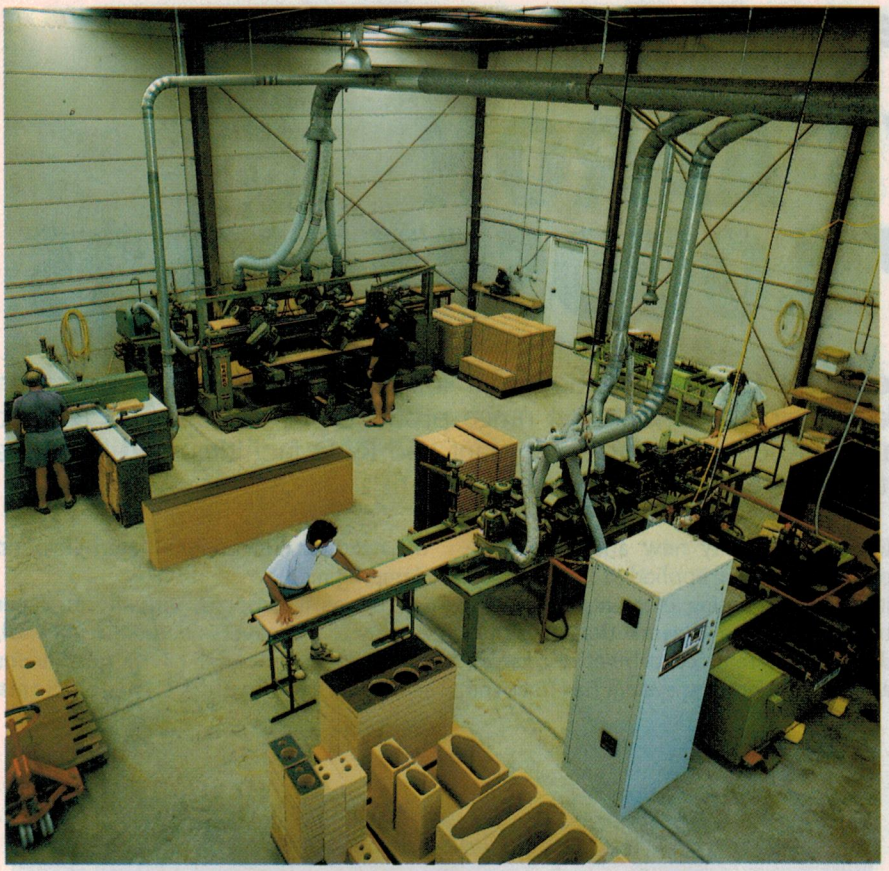
It has never been easy for loudspeaker system manufacturers to flourish in Australia, perhaps as a result of our small domestic market. That may well be why so many of our manufacturers have specialised in the high-end market, where the emphasis on quality rather than volume allows operation with relatively low overheads.

But one firm in particular seems to have bucked this trend: Betetec Industries, which has established an impressive manufacturing and R&D facility in Ballina, Northern NSW. The facility includes an automated mass-production plant, warehouse, showroom and development laboratory — complete with one of the largest privately-owned anechoic chambers in Australia. And from this facility they are delivering a steady stream of consumer-level speaker systems, high in quality but very competitively priced.

Fairly obviously, Betetec has made a substantial investment in loudspeaker system development and manufacture, which is quite unusual for an Australian firm. And their investment is paying



The photo at top shows Betetec founder and MD, Hume L'Estrange, who is himself a qualified engineer, operating a CAD system. Above left is a view inside the Betetec development laboratory, while at right is the inside of their anechoic chamber, with a small loudspeaker system being checked out using a calibrated microphone.



Inside the Betetec manufacturing plant. The automated machinery includes a high precision beam saw, a fully automatic linear groover, and a high speed grille-staining bath. Currently one pair of speakers can be produced every two minutes. A computer controlled testing system checks each finished speaker system for buzzes, rattles, frequency response, impedance, driver malfunction and other parameters.

off. But how have they achieved this, in a field where many others have had difficulty in surviving at all — and in a rural setting like Ballina?

Curious, we asked the company founder and managing director, Hume L'Estrange, who describes himself as 'an electrical engineer who discovered cabinet making'.

Here's his explanation:

"I started the company in 1980 with $3000 working capital, making hifi speaker systems in my wife's parents' garage, using hand tools. I soon realised that the only way to grow, at the time, was to produce speakers for other well-known brands — so then I leased a factory at Taren Point in southern Sydney, and started doing it."

"You see, the only way to set yourself up the way I am now is to do the hard work for established brands, and not waste energy trying to push your own brand..."

"The money I made from this was put back into the company, over the next eight years, buying automated manufacturing plant and equipment for my test lab."

"All the time, though, I had the goal to eventually develop and produce a well-known and respected brand of my own. So now, after 13 years, I have at last reached a position where I am able to try producing a product of my own, which I hope will gain respect not just here in Australia, but also overseas."

"I moved the factory to Ballina a couple of years ago for a number of reasons — one of which was a NSW Government grant, paying for the relocation of the factory and my family, which made it possible. The high unemployment in this area was a factor, for both ourselves and the Government. The fact that in Ballina we were also able to afford to buy the necessary land and build a factory of the required size, was also a major factor."

"The local Council went out of its way to assist us, by providing suitable land for us to purchase, plus assistance with development applications and the provision of power."

"From the standpoint of loudspeaker system production the climate was also important. In Ballina the temperature rarely falls below 16°C, below which the vee-grooving processes must be stopped because the vinyl becomes too brittle."

"In fact Ballina is only two hours from Brisbane, so the shipping costs are not particularly high, and any extra costs are more than offset by the cheaper running costs in such a location. I also believe that as time goes on, due to technology, location in this world will matter less and less."

Currently Betetec's facility extends over approximately 7000 square feet, and is divided into six areas: machine plant, assembly area, warehouse, office, showroom and laboratory.

The machine shop has up-to-date automated machinery, capable of producing one pair of speakers every two minutes. Among the machinery are a high precision, computer-controlled beam saw, a fully automatic linear groover and a high speed grille-staining bath which operates at the rate of one grille per three seconds. A quality control system tests each finished speaker enclosure for buzzes, rattles, frequency response, impedance, driver malfunction and even for drivers connected out of phase.

Like production, operation of the company is also computer controlled. Even invoicing can be arranged via modem, if clients are also equipped for this.

A lot of money has been invested in the Betetec laboratory, which has an impressive range of test gear and PC-based CAD systems. And of course there's also the anechoic chamber, of which Hume L'Estrange is justifiably proud.

Clearly Mr L'Estrange has a lot of faith in the future of speaker system manufacturing in Australia, to have made this investment.

He is confident that having established a world-class speaker design and manufacturing facility, and with a realistic emphasis on achieving a quality product at truly competitive prices, this investment will pay off — not only for Betetec, but also for Australia in terms of exports.

You'll find a review of one of Betetec's Aaron range of speaker systems in this issue, from our well-known reviewer Louis Challis.

For further information on Betetec Industries and its products, the firm can be contacted at 17 De Havilland Crescent, Ballina 2478; phone (066) 86 0277, or fax (066) 86 0285. ❖

BETETEC'S AARON 'ECLIPSE' LOUDSPEAKERS

This month the subject of reviewer Louis Challis' attention is a loudspeaker system of Australian manufacture: the Eclipse system, flagship in the new Aaron range produced by Ballina firm Betetec Industries. Betetec has invested heavily in both manufacturing plant and R&D facilities, and we were therefore very interested to see how the Eclipse system performed.

With the Australian dollar at an almost all-time low, and with sales at their lowest level for almost two decades, loudspeaker importers are having a difficult time. By contrast, local manufacturers are having a marginally easier time, and the number of new Australian speakers on the market is quite remarkable. Many of those speakers are of high quality, and a few are outstanding.

Most Australian loudspeaker manufacturers are selling speakers for which they have tried and proven design philosophies, underpinned by exhaustive subjective testing of their prototypes. By contrast, relatively few Australian manufacturers have bothered to invest in the resources needed to assess the objective performance of their speakers, and so it was with some surprise that I discovered that this had indeed been done by Betetec Industries, at Ballina on the northern NSW coast.

Betetec's latest development is the Aaron loudspeaker range. The development of these loudspeakers followed the construction of their anechoic room and the purchase of an impressive array of electronic testing equipment.

The idea of a local manufacturer constructing an anechoic room in a small town like Ballina is almost unprecedented. Ten years ago, there were only four or five such rooms in the whole of Australia. Today there must be closer to twenty such rooms, the largest of which has dimensions adequate for testing a large truck — which indicates just how large such a room really is.

The Aaron 'Eclipse' system enclosures have a somewhat sombre appearance, with a black cabinet and a neatly applied clip-on black cloth covered front panel. The cabinets are solidly constructed from heavy MDF board, with what is claimed to be a radically new and innovative philosophy being applied to the design of its internal bracing elements. I was intrigued by the claims that this has dramatically reduced cabinet resonance, and that the bracing system has removed the need for conventional internal sound damping media.

Now as it happens, virtually all other quality loudspeakers need such material, to overcome internal cavity resonances — so why shouldn't these? Some

manufacturers have gone even further, as evidenced by the B&W 'Matrix' cavity infill system, which has been proven to be not only desirable, but almost essential to effectively control unwanted cavity resonances. More about this later...

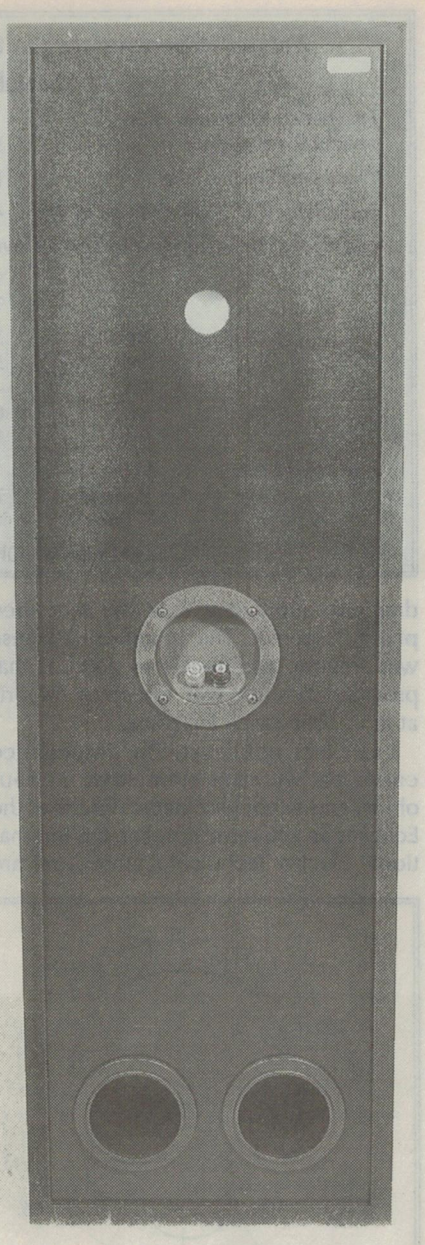
The Aaron 'Eclipse' loudspeakers are neat, slim and moderately heavy. They feature an unusual speaker design configuration with two bass drivers, a single mid-range driver immediately above with its own sub-enclosure, and a soft dome tweeter near the top of the cabinet.

When Hume L'Estrange, Betetec's Managing Director wrote to the magazine recently to tell us about his company's new locally designed Aaron loudspeakers and the almost unprecedented investment that his company had made in objective testing facilities, we were intrigued. I wasn't really surprised when that communication was soon followed by a pair of his company's 'top of the line' Eclipse loudspeakers for review.

Hume's description of their design features was interesting, if not perplexing. The Eclipse was claimed to use a 'Low Q Ratio alignment' which most of his competitors also use. However thereafter, any similarities between the 'Eclipses' and the competitive speakers, became much harder to identify.

Hume wrote to me, and suggested that I should examine the inside of the enclosure as I would note the absence of wool (or conventional fibre damping materials), and he claimed that the addition of its internal lateral brace, which had been specifically cut with an aperture in the shape of an eye, negated the need for internal absorptive material. This fancy brace was described as being a 'standing wave diffuser', developed by Betetec. What it purportedly does is to 'refract the waves in the box causing them to interfere with, and cancel each other'.

Whilst I could accept the comment that the panel 'refracts the waves', and that it 'causes interference', I had some difficulty digesting the 'cancellation' concept, except at a very limited number of frequencies, and I doubted that that would achieve very much.



Visible in this rear view of an Aaron 'Eclipse' speaker are the two ports for the bass sub-enclosure, at the bottom, and the smaller single port for the midrange sub-enclosure. As you can see, all of the ports face to the rear...

Hume's claim that the panel provides bracing at the critical point was obviously correct, but his additional claim that the panel 'stops standing waves' warranted much closer examination.

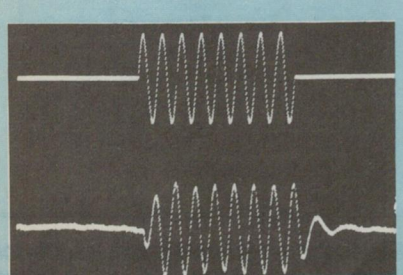
The two 200mm diameter woofers at the lower end of the cabinet share a pair of fairly large venting ports (each 120mm long by 70mm in diameter), at the lower rear edge of the cabinet. This was a design philosophy which was in vogue 20-30 years ago, but relatively few manufacturers use it now. One obvious problem with rear-venting ports, is the criticality of speaker placement relative to rear and side walls, and the impact it has on phase relationships between the front speakers and the sound emission components from the rear ports.

The 100mm diameter mid-range driver is installed in its own separately rear vented enclosure, directly above the two woofers. This unusual configuration of ported enclosure is claimed to 'reduce lower-midrange distortion', although this is not really explained. Nor is the claim that the sub-enclosure has been 'designed to keep most of the passband from coming through the rear venting port' adequately explained, to my mind.

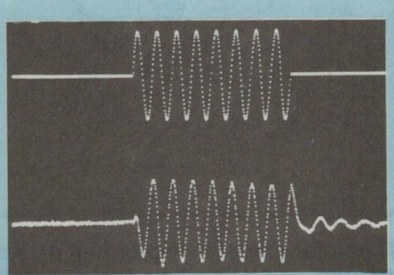
The computer designed crossovers have been designed to be free of resistors, and woofers and mid-range driver both use double layer covered speakers (polypropylene for the outer layer and compressed paper fibre for the inner). These speakers are specially manufactured for Betetec in South East Asia, to the company's own design and specification.

The 25mm dome tweeter apparently has some major performance enhancements when compared to comparable tweeters from other manufacturers, and although my testing confirmed that basi-

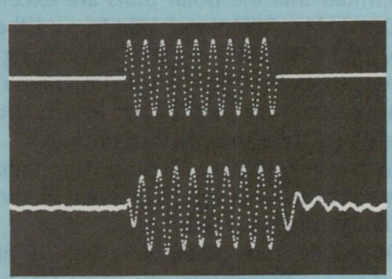
Tone Burst Response of the Aaron 'Eclipse' Loudspeakers
(for 90dB steady state SPL at 1m on Axis)
Upper trace is electrical input — lower trace is loudspeaker output



100Hz (20ms/div)



1kHz (2ms/div)



6.3kHz (0.5ms/div)

cally correct, the literature for the Eclipse model hadn't been printed at the time of shipping, and further clarification may have to wait until the future.

Objective tests

When I installed the first of the Eclipse loudspeakers on the turntable in my anechoic room and produced my first 'On-Axis' frequency response, even when making due allowance for the multiple rear ports (two low frequency and one mid-frequency port), I was concerned at the shape of the graph, and in particular the response 'step' at 500Hz and unexpected droop in output between 3kHz and 5kHz. I repeated the measurements with the microphone close to the individual drivers, and was even more disturbed by what I saw. I swapped the first loudspeaker enclosure with the second, to confirm that the phenomenon wasn't an isolated aberration — which it clearly wasn't. After a few moments' thought, I came to the conclusion that the cabinet's anti-resonant internal bracing element might well be producing the opposite effect of what had been claimed.

With my trusty screwdriver in hand, I quickly removed one of the 200mm drivers and gingerly inserted two reasonably large pieces of 'Pink Poly' polyester insulation blanket — which was fortuitously lying at the back of our laboratory, following the completion of another test. Then I reassembled the loudspeaker, and repeated the test.

The difference between the two curves was positively astounding. The 'hills and dales' had all but gone, as had the nasty response step (and obvious phase change) at 500Hz. The modified loudspeaker now produced a reasonably smooth response, +/-5dB from 50Hz to 20kHz, which most manufacturers would be pleased to claim as their own.

I decided then and there to modify the second speaker enclosure the same way, and to carry out my supplementary tests of the Eclipse enclosures with the Pink Poly in place. That testing immediately confirmed that the polar plots are excellent at 1kHz, 3kHz and 10kHz, and the only place where I could find any significant diminution in the horizontal bandwidth, was at 6.3kHz where the lobe was a trifle sharper than normal.

With the Pink Poly in place, the tone bursts proved to be much cleaner, as did the decay response spectra.

One of the most impressive features of the Aaron Eclipse with my 'supplementary polyester insulation', was the dramatic improvement in the measured phase response. The modified response was smooth, and frankly as good as that provided by some well respected imports at more than twice the price.

Last, but not least, the impedance curve shows consistent lows at four ohms, and although Betetec describes the Eclipses as a '6-ohm' speaker, the International Electro Technical Commission are adamant that this loudspeaker should be classified as a 4-ohm speaker.

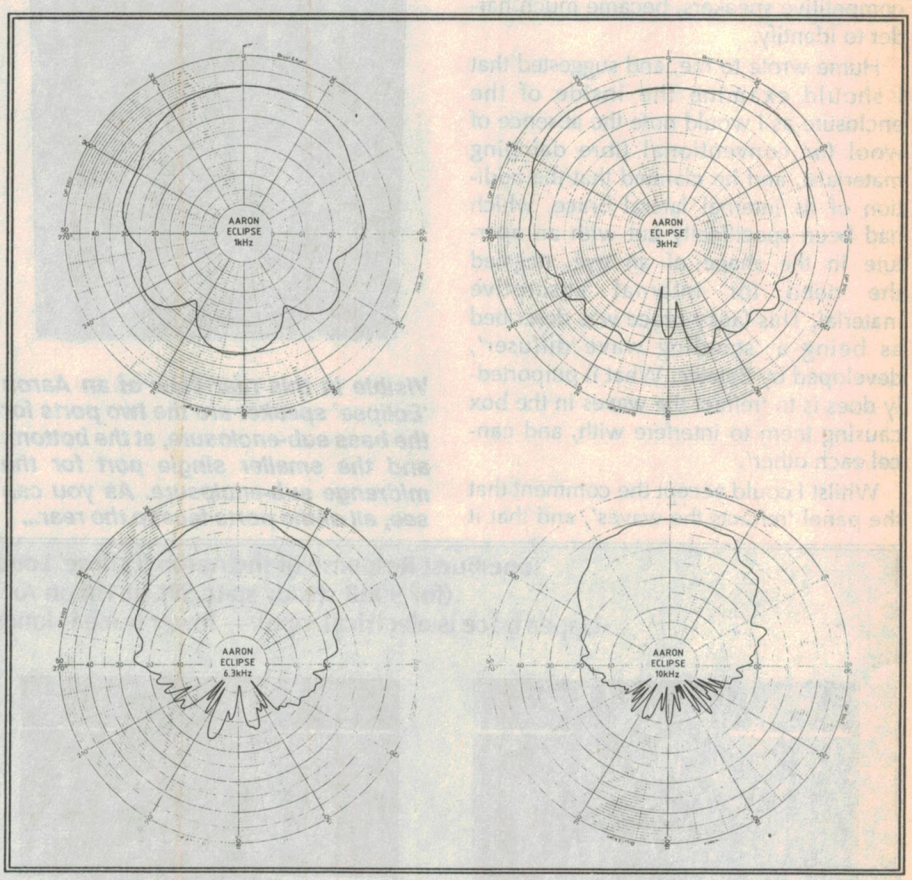
Measured performance of the Aaron 'Eclipse' Loudspeakers
Serial No 22543

Frequency Response under anechoic conditions		50Hz-60kHz +/-3dB		
Crossover Frequencies		Nominally 500Hz and 3kHz		
Sensitivity (for 90dB average at 1m)		4.7VRMS = 1.4 watts (nominal into 4 ohms)		
Harmonic Distortion (for indicated level at 1M0				
		100dB 100Hz	**100dB 1kHz**	**100dB 6.3kHz**
	2nd	36.8	60.9	39.7dB
	3rd	50.9	62.4	46.4dB
	4th	-	-	-
	5th	62.9	-	-
	THD	1.5%	0.12%	1.1%
Input Impedance	100Hz =	4.2 ohms		
	1kHz =	13 ohms		
	6.3kHz =	8.1 ohms		
	Minimum at 40Hz = 4 ohms			

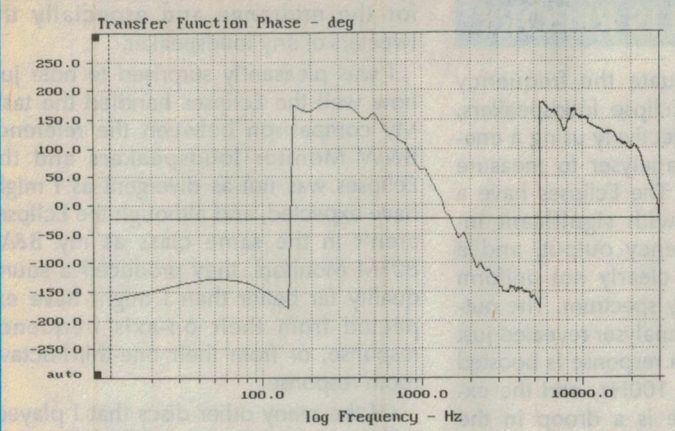
Listening tests

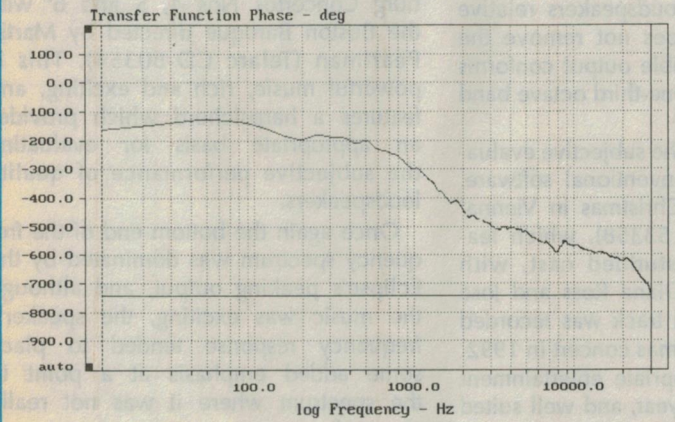
I decided to leave the Pink Poly in place for my subjective tests, and packing the two boxed loudspeaker enclosures into the boot of my car, soon had them installed in my living room.

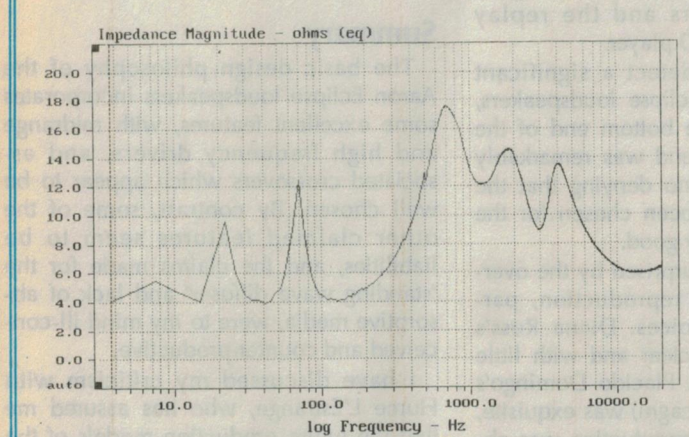
The first test I carried out was a pink

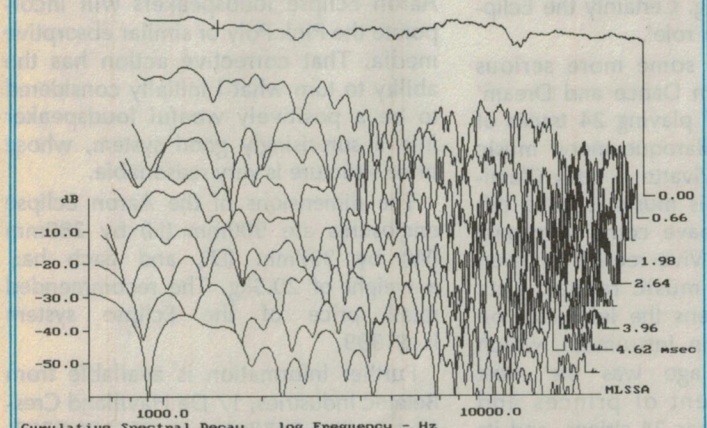


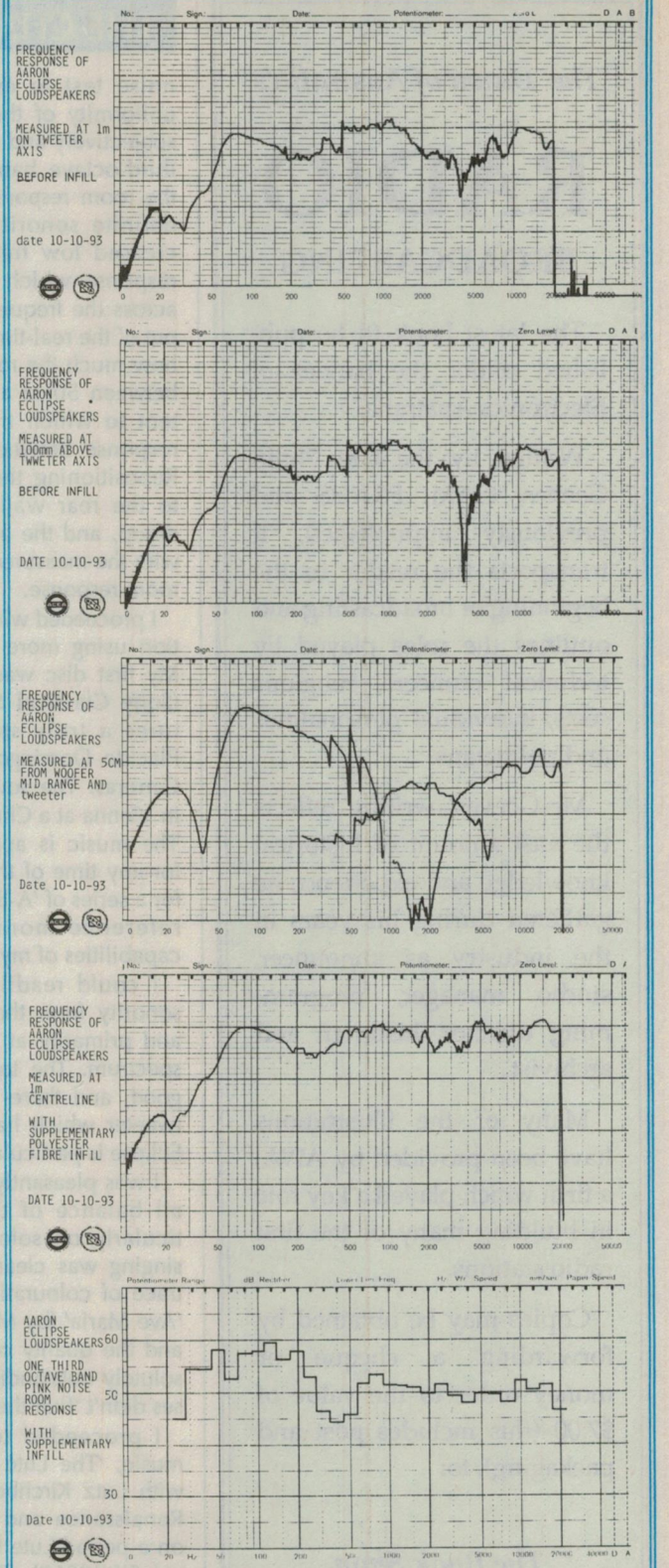
The polar dispersion plots for an Aaron 'Eclipse' speaker at higher frequencies. As you can see, they are generally very good, with only a small amount of narrowing of the main lobe at 6.3kHz and 10kHz.











Above: The main frequency response plots for the Aaron 'Eclipse'. Top shows the front response at 1m on the tweeter axis, and at 100mm higher next down. Then comes the responses at 50mm from the woofer, midrange and tweeter, and finally the overall and pink noise plots with the added fibre infill.

Left (from top): The 'wrapped' and 'unwrapped' phase plots for the Eclipse, followed by its impedance characteristic and cumulative spectral decay plot.

THE CHALLIS REPORT

noise test to evaluate the frequency uniformity of the Eclipse loudspeakers, subjectively and objectively using a one-third-octave band analyser to measure the room response. The Eclipses have a definite sonority, with significant increased low frequency output, and a response which is clearly not uniform across the frequency spectrum. The output of the real-time analyser revealed just how much the room response is boosted between 50Hz and 100Hz, and the extent to which there is a droop in the response between 250Hz and 600Hz. Repositioning the loudspeakers relative to the rear wall does not remove the droop, and the audible output conforms with the measured one-third octave band room response.

I proceeded with the subjective evaluation using more conventional software. My first disc was 'Christmas in Vienna' (Sony Classical SK 53358), which features a truly star-studded cast, with Placido Domingo, Diana Ross and Jose Carreras. The sound track was recorded in Vienna at a Christmas concert in 1992. The music is appropriate entertainment for any time of the year, and well suited for a series of 'A-B' comparisons using my reference monitors and the replay capabilities of my CD player.

I could readily detect a significant sonority from the Eclipse loudspeakers, and primarily at the bottom end of the spectrum. The top end was remarkably good, and there is no denying that the tweeter which has been chosen for the Eclipse is particularly good.

I was pleasantly surprised by the overall balance of the reproduction, particularly on solo voices. Diana Ross's singing was clean, clear and with little trace of colouration. Placido Domingo's 'Ave Maria' (by Mascagni) was exquisite, and the quality of reproduction was absolutely outstanding. Certainly the Eclipses didn't 'fluff their role'.

I proceeded to some more serious music, 'The Lute in Dance and Dream' with Lutz Kirchhof playing 24 tracks of Renaissance and Baroque mood music on a period Lute (Vivarte — Sony Classical SK-48068). This music is quite different to what I have come to expect from say, Musica Viva recitals or even from a chamber music recital. Lutz Kirchhof really opens the lid for us on an almost forgotten instrument, which only 400 years ago was the most popular instrument of princes and paupers. The lute has 24 strings, and its percussive output constitutes a fine test for the midrange and especially the tweeters of any loudspeaker.

I was pleasantly surprised to note just how well the Eclipses handled the task. My comparison between the reference B&W Monitor loudspeakers and the Eclipses was not as divergent as I might have expected, and although the Eclipses aren't in the same class as my B&W 801M Monitors, they produced a sound quality far better than I might have expected from their on-axis frequency response, or from their one-third-octave room response.

Of the many other discs that I played, the most notable was Bach's 'Brandenburg Concertos Nos 4, 5 and 6' with the Boston Baroque directed by Martin Pearlman (Telarc CD-80354). This is powerful music, rich and exciting, and features a harpsichord which provides an appropriate basis for evaluating the subjective performance of quality loudspeakers.

Once again the bottom end of the frequency spectrum was dominated by the Eclipse's peaking output, and although the music was exciting, the speaker's frequency response tended to place some added emphasis at a point in the spectrum where it was not really required.

Summary

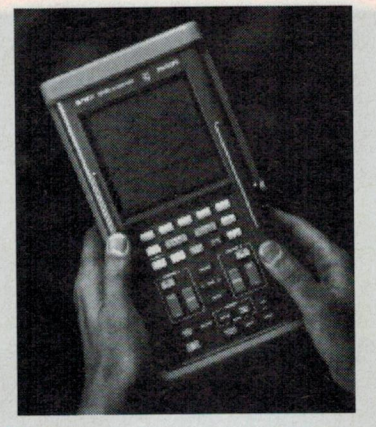
The basic design philosophy of the Aaron Eclipse loudspeakers incorporates some excellent features, with midrange and high frequency drivers, and associated crossovers which appear to be well chosen. By contrast, some of the other claimed features seem to be liabilities, and the claims made for the 'standing wave diffuser' and lack of absorptive media, were to my mind ill-conceived and counter-productive.

I have discussed my criticism with Hume L'Estrange, who has assured me that the future production models of the Aaron Eclipse loudspeakers will incorporate the Pink Poly or similar absorptive media. That corrective action has the ability to turn what I initially considered to be a positively woeful loudspeaker into a surprisingly good system, whose price structure is very reasonable.

The dimensions of the Aaron Eclipse enclosures are 900mm (H) by 280mm (W) by 397mm (D), and each has a weight of 20.5kg. The recommended retail price of the Eclipse system is $1399.

Further information is available from Betetec Industries, 17 De Havilland Crescent, Ballina 2478; phone (066) 86 0277, or fax (066) 86 0285. ❖

Fluke 90 Series 50MHz Digital Storage Scope plus...



- *25MS/s 2 ch. dig. storage*
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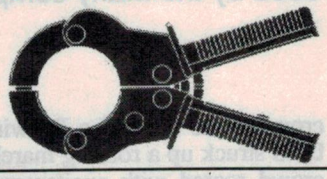

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Crossed Pairs	•		•
Reversed Pairs	•		•
Split Pairs[1]	•		•
Near-End Crosstalk(NEXT)[1]	•		•
Attenuation[1]	•		•
Characteristic Impedance	•	•	•
Termination Res.		•	
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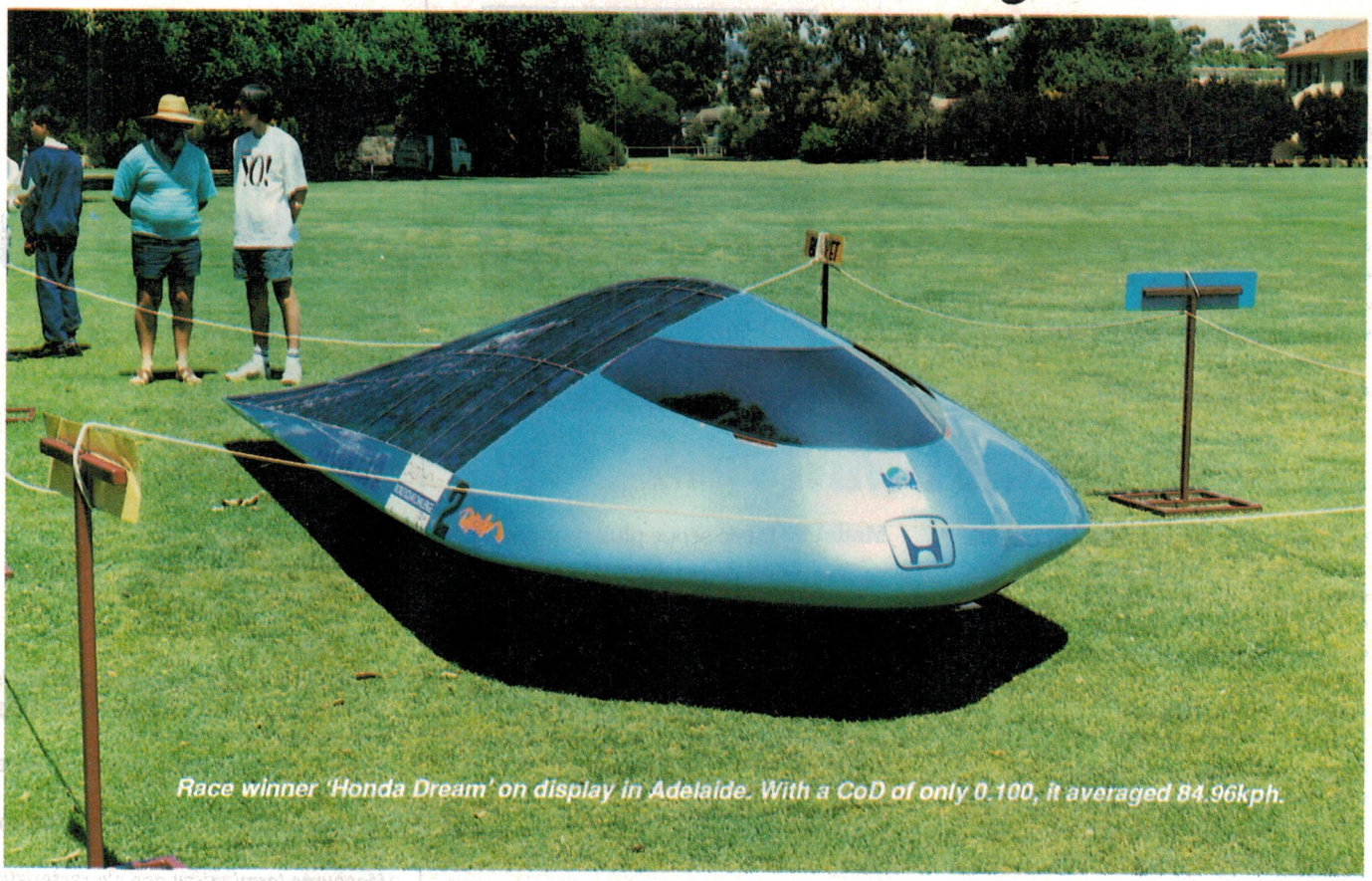
Report on the 1993 World Solar Challenge:



Race winner 'Honda Dream' on display in Adelaide. With a CoD of only 0.100, it averaged 84.96kph.

'PLANET EARTH'S GREATEST RACE'

The mass media gave relatively good coverage of the latest World Solar Challenge, and most people were made aware of the winners. But here's a report giving rather more detail about the race, and an insight into the technology used by the many competitors.

by DAVID JEANES

"Clear the track! Clear the track! The 1993 World Solar Challenge will start in 30 seconds. This is the greatest race on earth! 52 cars will storm down the Stuart Highway, 3500kms from Darwin to Adelaide, the longest racetrack in the world. The race starts in ten seconds; nine; eight; seven; six; five; four; three; two; one; GO! The 1993 World Solar Challenge has begun."

With his voice reaching a crescendo, race caller Richard King urged each car across the starting line, located in the heart of Darwin City. Media cameramen crowded the area. The Darwin military band struck up a rousing march, and the crowd roared with excitement. Almost sedately, *Spirit of Biel*, the Swiss car and winner of the 1990 race, purred away to lead the pack.

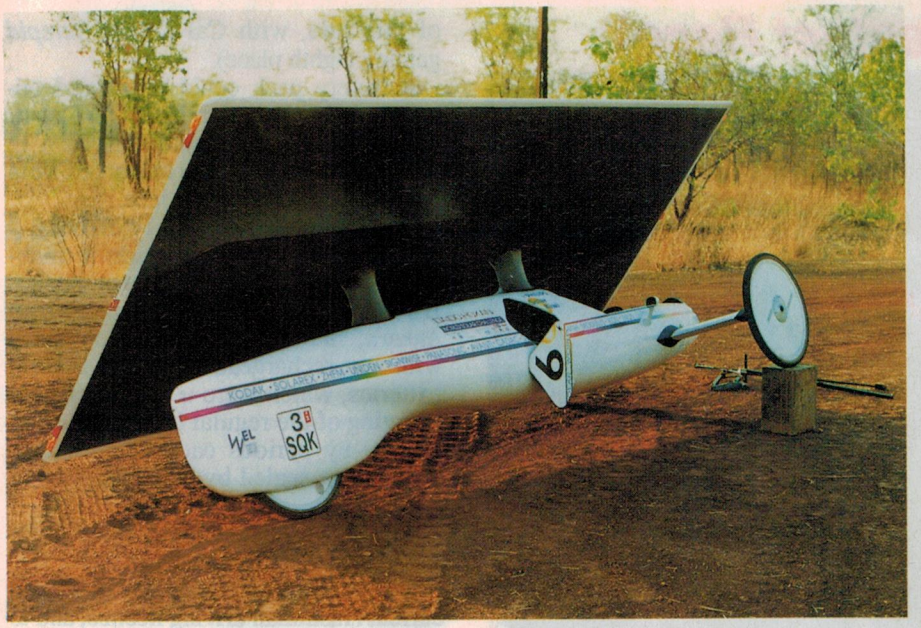
Race background

This event would be the third in a series of World Solar Challenges; the first was run in 1987 and won by GM's *Sunraycer*.

The second race in 1990 brought victory to the Swiss team, from the Biel Engineering School. In that race, Honda's *Dream* had come second.

As a result of the speed trials for the 1993 event, the Biel car was in first position on the starting grid, having clocked 129.9kph. The Honda *Dream* was in second position, having recorded a qualifying speed of 125.0kph. In 17th position, with a top speed of 83kph was the first Australian car, *Aurora*. During the race this vehicle was to overhaul a dozen of the world's top cars, to finish an amazing fifth.

The World Solar Challenge owes its



New Zealand's entry 'Solar Kiwi' tilted in the early morning sun to charge its batteries. Note the high tech prop used to jack up the front wheel...

origins to adventurer Hans Tholstrup. In 1982, Hans built and then drove, with partner Larry Perkins, the solar car *Quiet Achiever* from Perth to Sydney at an average speed of 23kph. Hans felt the need for a world challenge in solar car development, as a step towards the use of 'clean' power in automobiles.

The 1987 Pentax World Solar Challenge was the result. The international media provided unexpected coverage for this event, confirming that the 'Challenge' would become a fixture. This race was won by GM's remarkable *Sunraycer*, at an average speed of 66.92kph for the 3000km journey from Darwin to Adelaide.

The route

Where in the world, other than Australia's Stuart Highway, is there 3000km of smooth bitumen, running within the same time zone, in virtually the same direction all the way, with 2900km unimpeded by towns or intersections, and with the sun beating down mostly from overhead?

Add to this a positive enthusiasm from state and federal governments, ardent support from the inhabitants along the way, and the brilliant organisation of Hans Tholstrup's Energy Promotions, and there's really no better place to run such an event. Much of the success of this extraordinary race is due to this superb route.

The competitors

Fifty-two cars, drawn from 12 countries, started in the 1993 World Solar Challenge.

Twenty of the cars were from Japan, ten from Australia, and ten from the USA. Other countries represented were Germany (1), Canada (1), Denmark (1), Korea (1), England (3), Switzerland (2), Russia (1) Brazil (1), and New Zealand (1).

There was a tremendous diversity in entries, particularly in their budget allocations. A private UK entry, Team TR-50, had a budget of about $33,000 — which included air freight for the car and air travel for the three team members present. At the other end of the spectrum, the Honda car entrant was reported to have invested more than $10 million in the development, construction and logistics in bringing their car and team to Darwin.

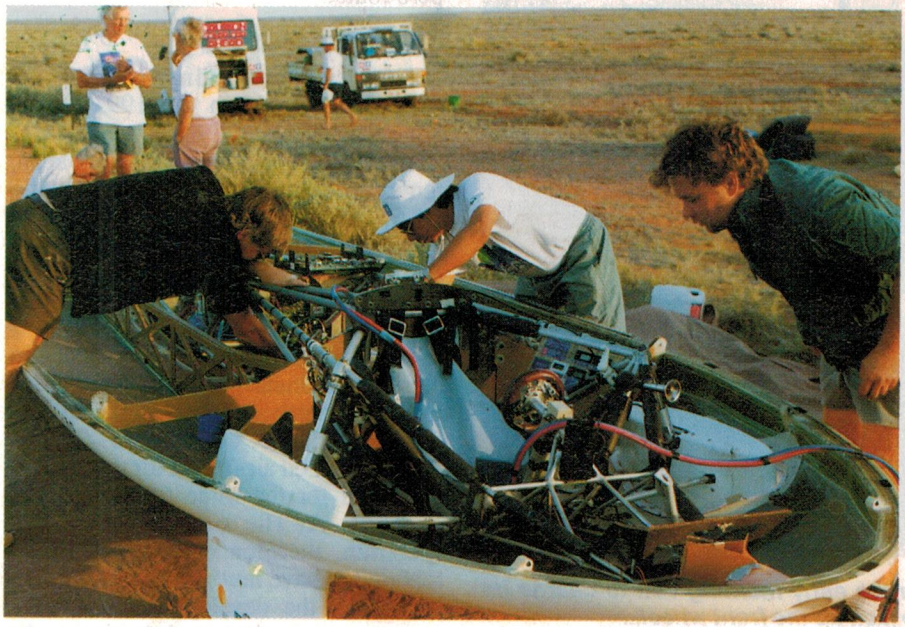
Great differences were also apparent in the design and construction of the various cars. The Honda *Dream* is a glorious looking machine, matched in appearance and design perhaps only by the Swiss *Spirit of Biel*. The mechanical and electronic excellence of these cars will surely

THE 1993 TOP 10 PLACE WINNERS

Pos.	Team	Car	Country	Avg Speed kph
1	Honda	Dream	Japan	84.96
2	Biel Eng.School	Spirit III	Switzerland	78.27
3	Kyocera	Son of Sun	Japan	70.76
4	Waseda Uni	Sky Blue Waseda	Japan	70.35
5	Aurora Veh. Assoc	Aurora Q1	Australia	70.08
6	Toyota	Toyota 56	Japan	64.71
7	NT University	Desert Rose	Australia	64.34
8	Cal. Poly Uni	Intrepid	USA	63.64
9	Geo. Washington Uni	Sunforce	USA	63.08
10	Be-Pal Magazine	Be-Pal III	Japan	61.96

Japanese magazine entry 'Be-Pal III' gets minor adjustments before the start of the race. It finished in tenth position.

'Planet Earth's Greatest Race'



NT Uni's entry 'Desert Rose' receiving pre-start checks on day 2, south of Katherine. The solar panel has been removed and propped nearby, to enable the batteries to be charged. Note the composite-plus-tubular frame construction.

speed the development of the electric street car of tomorrow.

In contrast, a number of entrants constrained by funds but not ingenuity, leaned heavily on bicycle components, orthodox electric motors and low cost solar cells, to produce cars clearly never intended for the winner's dais. *Their* great challenge was to compete and to finish the course.

Most heartening was the number of entries from universities and colleges. All of the entries from the USA were from universities. There were also cars from four Australian high schools, two being girls-only teams.

Of the first ten cars across the finishing line, five were from universities or colleges: the Biel Engineering School (2nd); Waseda University, Japan (4th); NT University (7th); California Poly Uni USA (8th); and George Washington Uni (9th).

This clearly emphasised the tremendous enthusiasm and motivation generated on campus by the design, construction and entry of a car in the World Solar Challenge. To many team members, it was the adventure of a lifetime.

The race rules

The regulations governing the cars and their conduct during the race took up six closely typed A4 pages. However, in essence the rules could be divided into a few simple statements:

The car could be propelled only by energy derived from direct global solar radiation. This could be collected by an array of photovoltaic cells with a total area of less than eight square metres, with dimensions able to be contained within a box two metres by four metres in the horizontal plane and 1.6 metres in height.

Cars carrying a driver AND a passenger were permitted to have the cells covering the whole surface of the car, providing up to two extra square metres of array. (Only five cars took advantage of this rule, with Cal Poly's *Intrepid* gaining eighth place).

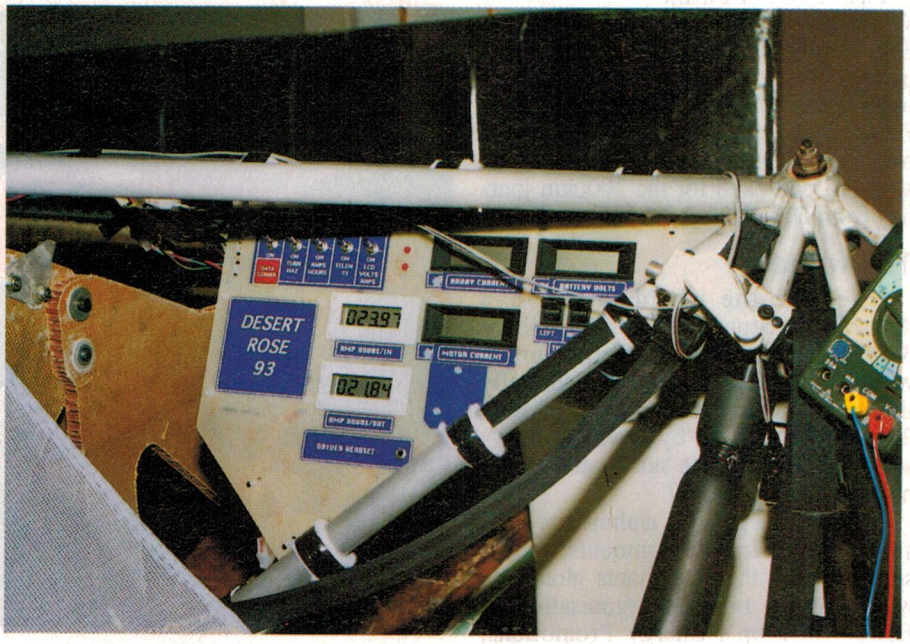
A battery pack could be carried onboard, fully charged prior to race start, with a capacity not greater than 5kW-h. These batteries could be recharged from the solar array during the race.

Most cars carried only from 2 - 3kW-h of battery capacity, as a trade-off of weight against reserve power. However one car, the Australian *Aurora*, made up the extra capacity with non-rechargeable dry cell lithium batteries, which were used to augment charging of the regular batteries during the lay-by periods each day. Battery packs were sealed by officials prior to the race.

Each car had to comply with the on-road regulations for the Northern Territory. Drivers were required to hold a current Australian driving licence, and to obey all road rules. Drivers were to have a weight of 80kg, with any shortfall to be made up from a 'personal lead ballast' package carried in the car. The combined crew weight for two-person cars was 160kg.

Cars could race only between the hours of 8am and 5pm Central time. Outside those hours the cars had to be parked off the road. However solar arrays could be removed from cars during the off-road periods, and could be erected to gain the best angle for solar energy pick-up from the low sun.

Each car required a support vehicle to drive ahead, warning oncoming traffic, with a second support vehicle behind, carrying the official observer — who at



A close up inside the cabin of NT Uni's 'Desert Rose', showing the control panel on the left hand side of the driver.

all times had to be within sight of the race car.

The cars

The basic parameters for a successful solar race car are almost self evident: light in weight, with great structural strength, maximum solar power recovery, a highly efficient propulsion and drive system, minimum coefficient of aerodynamic drag (CoD), and perhaps the ultimate: great reliability. These factors must be coupled with experienced drivers and an effective support team.

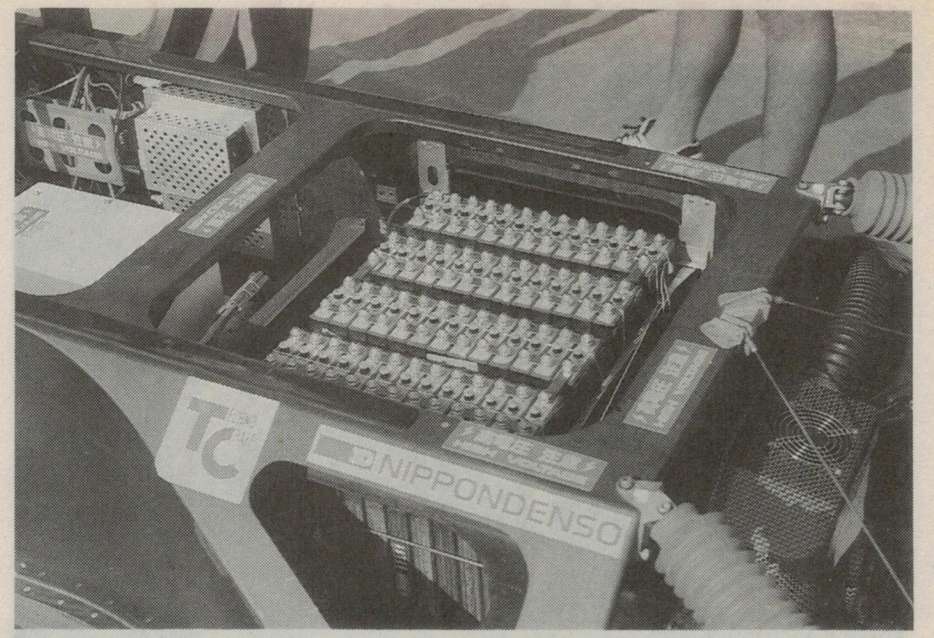
Light weight and strength in the construction of the leading cars has been obtained by use of high tensile steel and aircraft-quality aluminium tubing, together with ultra-lightweight honeycomb shells using Kevlar with carbon fibre strengthening, moulded to wind-tunnel tested body shapes providing maximum on-road stabilty and minimum drag.

The car suspensions copy a variety of proven automobile systems, but have to compromise the energy losses of a soft ride against the equipment-killing vibration created by low roll resistance tyres inflated up to 100psi...

Electric motors

The top cars used brushless DC motors, providing high electrical efficiency and mechanical output with low weight.

This type of motor comprises rare earth permanent magnets in the rotor, with field windings in the stator. When mounted as an integral part of the driving wheel assembly, an overall efficiency of up to 94% can be achieved overall — from solar array output through to the mechanical power delivered to the drive wheel.



The silver-zinc battery pack in the 'Toyota 56' car, which finished 6th.

Brushed DC motors, with permanent magnet stators and rotating armature windings, are cheaper but less efficient — and are also heavier than brushless motors. However good performance was achieved by the Australian car *Aurora*, using a brushed DC motor with modified low-loss brushes.

Power transmission

Three basic systems were used in transmitting power to the drive wheel(s). In order of theoretical efficiency, these are:

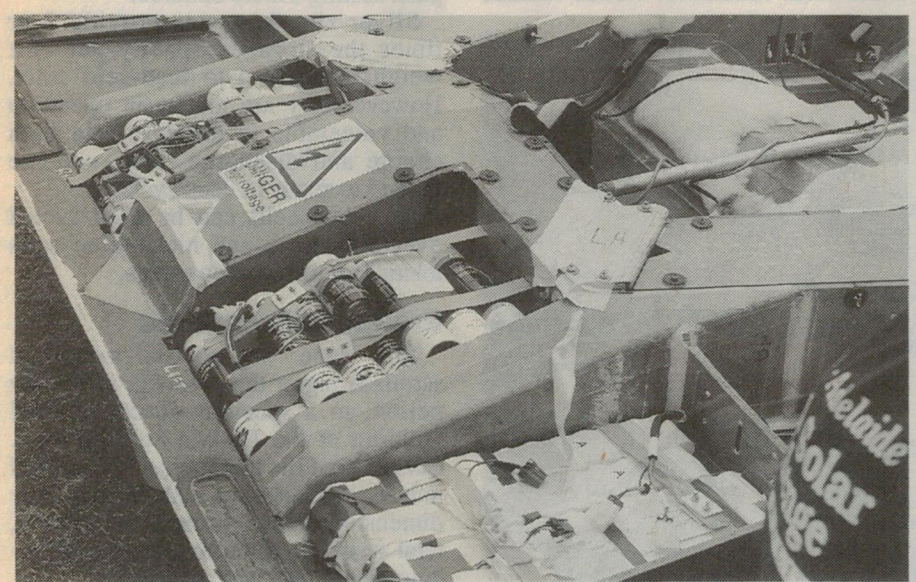
(1) the motor as an integral part of the wheel;

(2) a toothed belt between the motor drive shaft and the wheel; and

(3) a sprocket and chain assembly.

The Honda *Dream* (1st), *Spirit of Biel* (2nd) and *Desert Rose* (7th) all used integral motors in the drive wheel. The car placed third, Kyocera's *Son of Sun*, fourth place Waseda Uni's *Sky Blue* and fifth place *Aurora* all used a sprocket and chain system. Sixth place winner *Toyota 56* used a toothed belt drive.

Many 'budget' entrants used bicycle sprocket and chain drives with derailleur gear change systems.



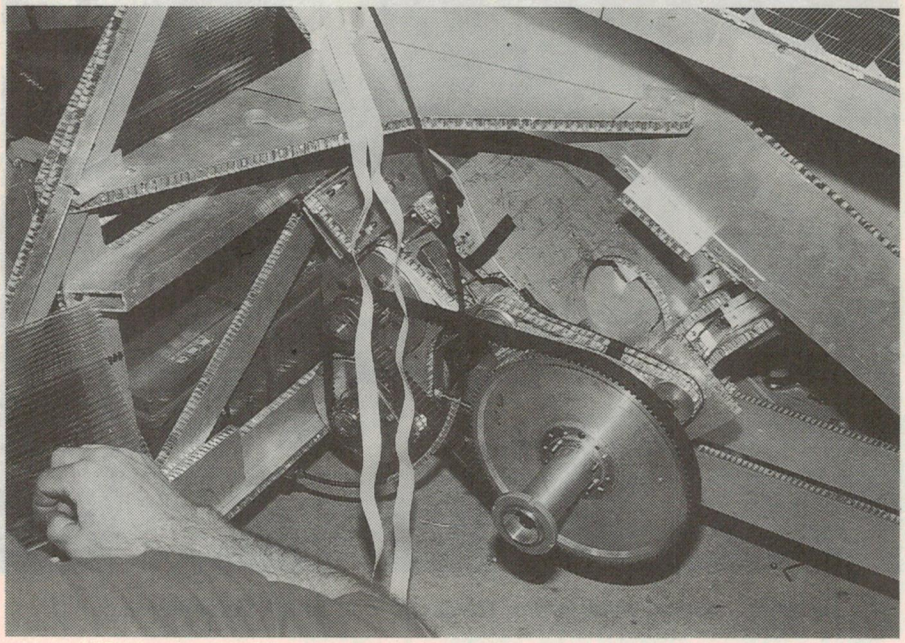
The triple battery packs used in Australia's diminutive entrant 'Aurora', which performed brilliantly and finished in 5th place. The lithium cell battery is in the compartment nearest the camera.

Solar arrays

Under ideal conditions, a square metre of the earth's surface is radiated by about 1100 watts of solar energy. An 8.0m^2 solar panel comprising 20% efficient cells operating at a temperature of 25°C could therefore, in theory, gather about 1760W of electrical power. With each degree rise in temperature, cell output drops by approximately 0.5%.

Actual on-road conditions can reduce the output of a solar car's array to less than 1000W. This reduction is due primarily to a proportion of the cells not being aimed directly at the sun, together with the effect of shadows from trees, and from cell temperature rise caused by inadequate ventilation.

A solar cell's output voltage is greatest under open circuit conditions. As a load is presented to the cell, output voltage drops, becoming zero when it's short cir-



A typical toothed-belt drive system, as used by a number of entrants. Note the 'honeycomb' aluminium panel material which forms this vehicle's frame.

cuited. There is an optimum value of circuit load which permits maximum cell output. Electronic components known as 'peak power trackers' sample cell voltage and adjust the load for maximum cell output. In each array, strings of cells are connected in series to provide the voltage necessary to charge the battery bank. Each string is controlled by a peak power tracker.

Notwithstanding the above explanations, the maximum electrical power extracted from a solar array is almost directly proportional to the funds available. Dr Martin Green of the University of NSW has developed laser-etched monocrystalline silicon solar cells with efficiencies ranging from 17% to 20%, and equal to the world's best. A 17% efficient 8m^2 solar car array, capable of producing 1.3kW would cost about $100,000. An array of 18% efficiency, providing 1.4kW, would cost about $200,000 or roughly double.

Top of the line 20%-efficient cells are available at $1.5 million for an 8m^2 array, capable of producing 1.56kW under ideal conditions. Honda claimed an efficiency of 21.2% from the 4584 cells in their car's array.

The *Spirit of Biel* cells were stated to have an efficiency of 20%, and Kyocera's *Son of Sun* cells gave 18.5% efficiency. University of Michigan's car *Maize and Blue* had a mix of cells ranging from 16% to 19%, with an estimated theoretical panel output of 1300W. Their 15kg brushless DC motor, running on 85V from the car's batteries, could give a peak output of 8hp (6kW) at 2250rpm.

Two of the University of Michigan's support vehicles. The large semi-trailer contained a full machine shop, plus an extensive spare parts inventory.

Body shape

The requirement for the lowest possible coefficient of drag (CoD) requires body shapes which prevent a significant portion of the car's array from obtaining an optimum view of the sun. As a result, the maximum solar power available from the panel whilst under way varies between about 700 and 1000W. To travel over 60kph with this amount of power requires a CoD of about 0.13.

The published CoD for NT University's *Desert Rose* is in fact 0.13, while the University of Michigan's *Maize and Blue* claims 0.110. The *Spirit of Biel* is even better at 0.105, while the Honda *Dream* is a very low 0.100.

Batteries

All four top-placed cars used silver-zinc batteries. The amazing fifth placed Australian car *Aurora* used Gates lead-acid gel cells, with lithium primary cells as a one shot back-up.

Several cars used nickel-zinc batteries, while some 20 cars used lead-acid batteries. Seventh placed Australian car *Desert Rose* used a silver-zinc battery pack costing a mere $25,000!

Silver-zinc batteries provide four times the storage capacity per unit weight compared to lead-acid cells. However they are touchy in operation and vulnerable to damage from high charge and discharge rates, and are limited to about 15 deep cycles.

Lead-acid cells can be deep cycled over 500 times and nickel-zinc cells tolerate up to 100 deep cycles.

Pre-race procedures

The race organisers arranged scrutineering of the cars over a two-day period, in a spacious air-conditioned building at the Darwin showgrounds. Cars entered the building and proceeded to bays where aspects such as solar array dimensions, battery pack parameters, total vehicle weight, roadworthiness requirements, etc., were examined.

In an adjacent building (not air-conditioned), entrants could assemble and static test cars prior to scrutineering.

Meantime drivers were weighed, and if required, were provided with their personal lead shot ballast pack.

The second phase of preliminaries comprised the speed and stability trials. On Saturday November 6, the day before race start, all cars were required to travel at top speed along a drag strip at Darwin's Hidden Valley Raceway. The measured top speed decided the car's position on the starting grid.

During each speed run, a three-unit road train roared past in the opposite direction at 80kph. An NT Road Transport vehicle, carrying an inspector, followed the race car to evaluate the solar car's ability to withstand the tremendous wind gusts so generated. All cars survived this ordeal...

The actual race

Cars began lining up on their grid position in Darwin City from 6am on Sunday morning, 7th November. *Spirit of Biel* took pride of place under the start banner, having clocked almost 130kph at the speed test. Honda's *Dream* was alongside, ringed by serious-faced crewmen in immaculate white overalls. Thousands of Darwinians crowded the area, outnumbering the assembled media by a small margin!

As the starter's flag fell, right on 8am Central time, *Spirit of Biel* headed the pack down The Esplanade, missing the crowding photographers and onlookers by inches. A clear sky heralded a fast passage for the 330km run down to Katherine.

The writer had to return to the caravan park to hitch up to his van, but managed to head south by 10am. Some 29 cars were passed on the way to Katherine, with the remainder of the field well ahead, down 'the track'.

Race rules required a minimum speed capability of 38kph for qualifying cars. Theoretically this would enable all cars to pass Katherine by 5pm of Day One. However five cars retired north of Katherine, and two cars withdrew at Katherine. The Moscow entrant travelled only 35km, averaging 9.77kph before retiring.

During the six days of our drive down to Adelaide, we developed a pattern of arriving early at a van park stop, then making a 6am departure. This enabled us to overtake various cars at their overnight camps, and gave great photo opportunities.

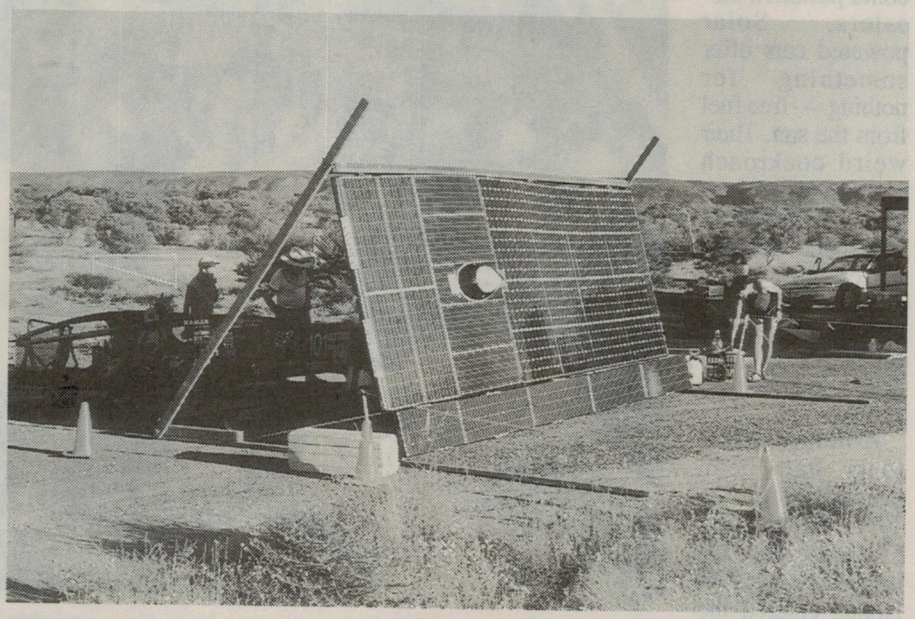
On Day One the leaders Honda, Biel, Kyocera and Waseda Uni were well ahead and were never sighted. But we paced the next group of cars and eventually arrived in Adelaide in time to see *Desert Rose* and *Toyota 56* cross the finish line. The weather was very hot along the way, with temperatures over 40°C at some places. Minimums seldom dropped below 30°C and many competitors were distressed by the heat.

The Uni of Puerto Rico's 'Discovery 500' car receiving final attention at the Darwin start line. It managed a creditable 48kph.

For the leaders, the sky remained clear or slightly overcast by high cloud most of the way, providing conditions which gave a record run — with the winning car, Honda *Dream* averaging 84.96kph and cutting several hours off the record set by GM's *Sunraycer* in 1987.

Although the media gave tremendous coverage for this event, dwelling at length on the leading cars, the real human interest stories were of the tail-enders. lagued by equipment failure, lack of spare parts, inadequate support facilities, diminishing funds and the cruel heat of the Territory, they persisted almost beyond the limits of human endurance in their efforts to reach the finishing line. Many were students in their mid-teens, striving for a performance that should make this country proud.

For this whole, tremendously exciting adventure, we undoubtedly owe a great debt to the organiser, Hans Tholstrup. ❖



The solar panel from Stanford Uni's huge 'Sunburner' car, taken off the vehicle and tilted to catch the sun's early morning rays, while the car is checked out.

Honda's Dream Comes True

(and shows the way for electric cars in the future)

As the official media liaison officer for the 1993 World Solar Challenge race, Brian Woodward had a unique insight into the effort and technical achievements invested in the winning entrants. At our invitation he provided the following summary of the background to the 1993 WSC, and its likely implications for the future of electric and specifically solar powered cars.

by BRIAN WOODWARD

When the A$10 million *Honda Dream* hummed over the finish line of the 1993 World Solar Challenge (WSC) on the morning of Thursday 11 November, the world's media went crazy.

As the day progressed, four more solar powered cars had bisected the vast Australian continent, and reached the finish line to cheers and champagne. International television and newspaper picture agencies redoubled their demands for more images, more stories. Racing 3013km from Darwin to Adelaide using no energy but the power of the sun, at an average speed of 86kph, obviously caught the world's imagination. Why?

Solar powered cars have all the romance of future technology. They offer hope in a world where environmental rumours daily become pollution disasters. Solar powered cars offer something for nothing — free fuel from the sun. Their weird cockroach shape and the barren Australian landscape through which they race, makes them working science fiction fantasies — like space mobiles on earth.

Honda's R&D team had been preparing for the 1993 World Solar Challenge since the last WSC in 1990. Honda entered the 1990 event with a car which, on paper, should have won. Its solar cells were claimed to be the best, and its weight and aerodynamics as good (if not better) than any other car. Light weight and good aerodynamics are important to a solar race car.

But the cells gave less power than anticipated, and bad weather forced the *Honda Dream* to charge and discharge its batteries three times a day. The very expensive (about A$40,000) space-race silver zinc batteries can only give maximum storage for 10 cycles.

After that, they're progressively less useful. ("Ten discharges and they are only good for making knives and forks", said one expert). In three days, the Honda's batteries were 'fried', according to one team member. The batteries are sealed at the start and cannot be replaced during the race.

Need to win

When a multi-national corporation with a reputation for excellent R&D is beaten by a small European engineering school, the need to win becomes paramount.

Yet the spirit of scientific camaraderie is so strong amongst solar racers that Fredy Sidler, the head of Biel's 1990 winning team, invited Honda's Takahiro Iwata to visit Switzerland and compare notes on solar race car technology.

Iwata obviously listened, because the two teams lined up, side-by-side, on pole position for the start of the 1993 WSC. Honda's R&D folk had experience in Formula 1 racing, and it was no surprise when a qualifying motor was fitted to the Honda for the high speed stability test at Darwin's Hidden Valley motor racing circuit. The Honda streaked down the race track at a staggering 125kph.

Biel's team manager had said, "We will reach 130kph". The *Spirit of Biel III* qualified with the fastest time of day at 129.9kph, and rumour has it that the engineer who had miscalculated the 0.1kph error went to the local K-mart to find a

Masashi Yamamoto, the Honda Dream's number one driver, drove the car over the finishing line in Adelaide's Bonython Park to champagne and cheers.

AP photographer Trevor Collens indicates the compact size of Honda's all-in-one electric motor, wheel and tyre. Honda carried spares, including a 'hot' motor for the speed qualifying event before the race started.

knife to disembowel himself. Not true, of course, but an indication of how refined the computer management system is on a solar race car. The Biel team had also fitted a qualifying motor to its car.

The week leading up to the event had become a two-car race. Other teams were ignored by the media. This was A Bad Thing (ABT: a three-letter acronym or TLA, like IBM), because there were many worthy teams deserving attention. But a problem with Honda's battery had transformed the 1993 WSC from a curious event for scientists and greenfreaks into just another motor sports event, with rumours — and rumours of rumours — between teams.

Honda's damaged batteries in 1990 had led the company's R&D team to specify Yuasa to make silver zinc batteries with considerably more silver, so they could be recycled many times over.

This made them heavier, and rumours started circulating with the implication that Honda's batteries were in excess of the 5kWh (kilowatt hours) specified for the race.

The rumours became so insistent that Honda's Takahiro Iwata enlisted the help of Dr David Rand of the CSIRO (Australia's government scientific body, the Commonwealth Scientific and Industrial Research Organisation). David Rand is the WSC's battery expert and one of the four most knowledgeable folk on this planet when the subject of batteries arises.

A 20-hour laboratory test of a *Honda Dream* battery confirmed that the car's batteries were legal and within specifications. The test proved that Honda's story about extra silver was true and accurate, and that the rumours were false.

It is interesting to note that Honda's *Dream* was chosen for the 'Non-Protest' rumour mongering about its Yuasa batteries, and not Nissan's car — which used exactly the same batteries. Could this be because the Nissan car was seen as no real competition for the *Spirit of Biel III*?

The actual race

The flag dropped and at least 50 solar powered cars headed south from Darwin. For a short time the *Spirit of Biel III* was in the lead. The car suffered a mishap when the carbon fibre fairing around the front left wheel hit a kerb and started rubbing on the tyre. This sapped power and, for a time, the engineers imagined the problem was electrical, not mechanical. The problem was to plague *Biel* for several days, and permitted Honda to draw further and further ahead.

Honda would have won even if *Biel* had not suffered the problem with its front left wheel. The *Honda Dream* was faster everywhere, except in top speed.

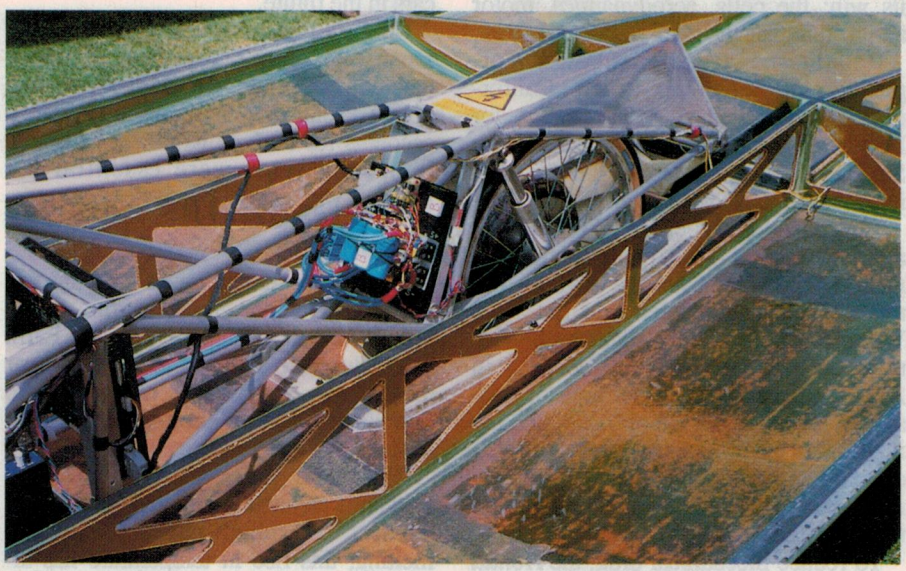
By the third day, Honda's lead was clear and on the fourth day of racing excitement grew, because there was a chance that Honda's *Dream* would reach the end of the 3013km race in Adelaide.

The excitement became dramatic when the *Dream* slowed and stopped, on one of the few hills in the event. Team members surrounded the car and raised its body, while technicians probed the car's on-board computer. They lifted the rear of the car and for a few seconds the motor fired into life and they all smiled, replaced the body and the car accelerated away.

For reasons that are not understood, the car's computer simply forgot all that it knew. The computer was reset — like a personal computer being rebooted — and performed faultlessly once more.

A few flat tyres also added time, and by late afternoon it became obvious that Honda's rush for Adelaide would be thwarted. With a touch of irony which suggests that a superior being in heaven was perhaps watching the race, the Honda stopped racing on the fourth day in a small town named Lower Light. The car was only a few hours from the finish line. So near, and yet so far...

Strong winds the next morning kept speeds down to a conservative level, but the *Honda Dream*'s lead was almost three



Judged the most innovative technical contribution to the 1993 World Solar Challenge, the hub motor of the University of the Northern Territory's Desert Rose car showed excellent performance from this low budget entry.

Honda's Dream

hours over the *Spirit of Biel III* and the team was determined that no mishap would rob them of their win.

Honda's *Dream* averaged a staggering 84.96kph (52.8mph) for the 3013.3km (1872.4 mile) race, demolishing the record set six years earlier by the GM *Sunraycer*. In fact the first five cars over the finish line broke the *Sunraycer*'s record. Their average speeds were: Biel 78.27kph, Kyocera Corp of Japan 70.76kph, Waseda University from Japan 70.35kph and the Aurora Q1 from Australia 70.08kph.

The first US car home was the *Intrepid*, a clever two-seater from Cal Poly Pomona which came in at 63.64kph. To save space and reduce the car's aerodynamic impact, the passenger sat behind the driver, facing rearwards. This back-to-back seating arrangement intrigued the media, which dubbed the *Intrepid* the 'safe sex' solar race car.

As proof of the Honda's technical superiority and precise computer management, a quick scan of the specifications published by Honda before the event reveals a comment that the *Dream* has 'an energy balancing speed of more than 86kph'. Subtract the time out to replace flat tyres and reset the computer on the fourth day, and you have 84.96kph — the Honda's winning speed.

Technical features

Obviously a vehicle which can travel 3013km within 1.04kph of its maker's specifications must be technically interesting. Apart from its superb reliability, four major technical features gave Honda its win: the cells, aerodynamics, motor and rolling resistance.

Relative newcomer SunPower Corporation of Sunnyvale (true!), California provided the solar cells for Honda's *Dream*. At 21.2% efficiency, the SunPower cells proved to be the best in the race.

With a Cd (drag coefficient) of 0.10 and a frontal area of 1.14 square metres, the *Honda Dream* was not the smallest nor most slippery of the cars in the 1993 World Solar Challenge. The highly innovative *Aurora Q1* from Geelong in Australia claimed a frontal area of 0.75 square metres and a Cd of 0.095, making it probably the most aerodynamically efficient car ever to roll a wheel on a public road. But Honda's Cd was up there with the top 10 solar racers.

To reduce mechanical drag, the *Honda Dream*'s motor is integral with the rear wheel. Imagine an electric motor for a moment. The rotor inside the motor turns and the outer part, the stator, remains still. Honda's motor reverses this. The inner part is clamped to the car's frame and the outer part is fitted with a tyre and rolls along the road. The motor's continuous power is 1.5kW (2bhp) at its maximum of 1100rpm; when needed, it can develop 6.0kW (8bhp). It weighs just 12.8kg (28lb) and was designed and made by Honda.

The *Spirit of Biel III* and the car entered by Australia's University of the Northern Territory (NTU) also used hub motors. Honda's offered 95% efficiency, the *Biel III* motor 97% and the NTU car's motor 96%. These figures compare with 83% for most advanced conventional electric motors. It is possible to state that these are the motors which will be used in electric cars in the future.

Honda's tyres, developed by Inoue of Japan, offer much lower rolling resistance than conventional tyres. At speeds below 60kph a solar race car's rolling resistance accounts for 30% of its power needs, so improved tyres were essential for Honda's win.

The University of Michigan team's communications support vehicle bristled with equipment. Apart from two way radio, it had telemetry with the race car's electronics, and a link to a forward car monitoring the weather.

A solar future?

As the race started, news bulletins announced that the hole in the ozone layer over the southern part of Earth had reduced to 30% — lower than ever expected — and was 28 million square kilometres (10.8 million square miles) in size.

Greenhouse gases generated this century have resulted in a global warming of about 1°C. Without any polar ice cap melting, this rise in temperature has already resulted in the oceans expanding and rising 300mm (11.8in). Without solar power, life is looking bleak.

After the 1987 World Solar Challenge, policy- makers from California used the viability of the winning GM *Sunraycer* to formulate the Zero Emission Vehicle (ZEV) legislation. By 1998, 2% of new cars sold in California must be ZEV. This means battery powered, and to the victor of the 1993 and 1996 World Solar Challenges goes the intellectual leadership when advertising electric vehicles.

But of all the worldly benefits which come from solar car racing, the most important has been achieved by Professor Martin Green of the University of New South Wales in Sydney, Australia. He is often called the 'father of modern solar car racing', and certainly, a total of 40,000 watts of his cells were used in many of the race cars in the 1993 WSC.

However in 1987, mainstream production solar cells cost A$400 per peak watt. Martin Green's work has not been to improve on 22% efficiency, but to develop new manufacturing technologies to reduce the price of solar cells. Today, effective solar cells can cost as little as A$6 per peak watt.

Martin Green claims that A$2 per peak watt will be achieved before the end of this century. At that price, solar cells become competitive with coal for generating electricity. Then, and only then, do ZEV's become truly ZEV. Until then, the Zero Pollution simply means 'polluting somewhere else' when the time comes to recharge an electric car's batteries.

Will the world ever see solar powered cars? Sure, but the solar cells may not be on top of the car — making it look like a racing cockroach. The cells will be in deserts and mountain tops, gathering clean electricity for a quiet, sweet smelling car of the future. ❖

THE SERVICEMAN

All kinds of hassles with some @#%?!@ dishwashers!

Although most of us are undoubtedly more comfortable tackling faults in familiar 'straight' electronic appliances like colour TV's, video recorders and CD players, there often comes a time when we have to 'have a go' at fixing electrical appliances with very little electronics — like (gulp!) dishwashers. This month we have the gruesome tale of one reader's encounters with these arcane contraptions...

Once upon a time, there were no radio and TV servicemen. It was a long time ago I must admit — but truly, there was once a time when there *were* no radios or TV's to be serviced.

Then, as time passed, a few clever people found that they were able to repair the proliferating radios and other electrical appliances, so they set up shop as the local Mr Fixit.

I remember that during my childhood, Mum took her electric iron to the radio shop when it needed repairs. The radio repairman also fixed electric fans, toasters and radiators, and any other electrical device that needed attention. In those days there weren't many appliances of any kind and most repairmen had to be versatile and able to tackle anything.

Unfortunately, those sorts of talents are in short supply these days. Most of today's Mr Fixits stick to just one product, and quite often to just one *brand* within that one product. The serviceman who can 'fix anything' is a rare treasure and customers who know of such a gem guard the knowledge carefully.

All of which ravings were brought about by a contribution from K.W., of Lane Cove in NSW. Regular readers will realise that K.W. is not new to these pages, having previously told us about some imaginative repairs to his parents' colour TV. Now he's back with a story that puts him firmly among the ranks of the long-lost Mr Fixits of this world.

This is not a story about electronics. In fact the subject barely gets a mention. But it is a story about repairing electrical appliances and customers, and being willing to tackle anything. So It deserves a place in these pages.

(In the past I have been chided for using these pages to discuss subjects other than domestic television and video recorders. Readers of that mind might like to stop here. This subject won't be a regular diversion, but just occasionally we will talk about things other than TV and VCRs.)

As K.W. reminds us in his opening paragraphs, he is not an appliance serviceman. But through being enthusiastic and imaginative, he can come to terms with almost any household appliance that he meets. As his title implies, he doesn't like them, but he can still fix them. Read on:

@?#!*% dishwashers!

I hate @$#!*?! dishwashers! Of all the electrical appliances (i.e., 'whitegoods') I've had the misfortune to get involved over with over the years, @$#!?! dishwashers would have to be the worst.*

The appliances themselves are bad enough — usually stuffed away under a grotty sink, with a great tangle of hoses that never want to go back properly, but I think it's also got a lot to do with the sort of person who buys them. (To save space, in the following text the term 'dishwasher' should be understood to mean '@$#!?! dishwasher').*

Until I moved to Sydney about five years ago, I'd never had anything to do with dishwashers. Nobody I knew owned one, and I'd never even seen one in action, except on TV! Unfortunately, one of my new neighbours soon changed all that.

Twenty-five years old (the dishwasher, not the neighbour — I wouldn't have minded so much then), it was the most ghastly appliance I've ever had the misfortune to get involved with. For 'political' reasons I got dragged into the foray after the 'poor old dear' was somewhat curtly told by an appliance repairman it wasn't worth fixing. (He was spot on, there!)

My service background is in TV and video, so I had virtually no idea how the things even worked, much less about how to fix them. And I protested as much, but to no avail. I got home one day to find her son had helpfully uncoupled it and dragged it out onto the back verandah 'for me'. Actually, in that instance the problem turned out to be pretty obvious — just a ruptured motor-start capacitor on the wash pump. Fortuitously, someone up the road had put out an old washing machine for council collection and I was able to scrounge a suitable replacement from that.

At the time I had only the vaguest idea what the motor actually did, but it fixed the problem and that was all I cared about. But over the next couple of years

the old horror (the dishwasher, that is) suffered various further breakdowns, mostly to do with the decaying wiring. With all the heat and humidity involved, PVC wiring and crimp connectors don't fare too well after 25 years!

By word-of-mouth I was also lumbered with a number of other dishwasher repairs around the district. I didn't enjoy these either, but in those cases I actually got paid, so I didn't mind quite so much!

Then one day the old dear's heater element blew and I thought that would be the end of it. The dishwasher's name badge had long since faded away so I had absolutely no idea who made it or where one might get a replacement. (Or even if you could GET parts, which I doubted).

She found one!

But foolishly, I took the element out so the owner could try to track one down 'on foot'. And she did, the very next day, from a place not 300 metres from where I worked! It turned out the dishwasher was made by ASEA of Sweden, and, cosmetic changes aside, it's still a current model! Aside from the heater, she was able to get a new cutlery basket, new springs for the door, new rollers for the dish racks and various other bits and pieces. Groan!

Recently, however, I moved to another part of Lane Cove, and hoped that the old dear didn't have my new address or phone number. Never again I thought — but it wasn't to be.

It wasn't long before I was dragged into another 'politically motivated' repair, this time a neighbour's VCR with a rental tape jammed inside. Fortunately this turned out to be quite routine, and at least she made me a cup of tea afterwards. (The other old biddy wouldn't even do that much!)

Unfortunately, that cup of tea proved my undoing. This woman also had a dishwasher, although it was only a couple of years old, with an electronic control system. As I placed my empty cup in the machine, I noticed there was a pool of scummy water in the bottom.

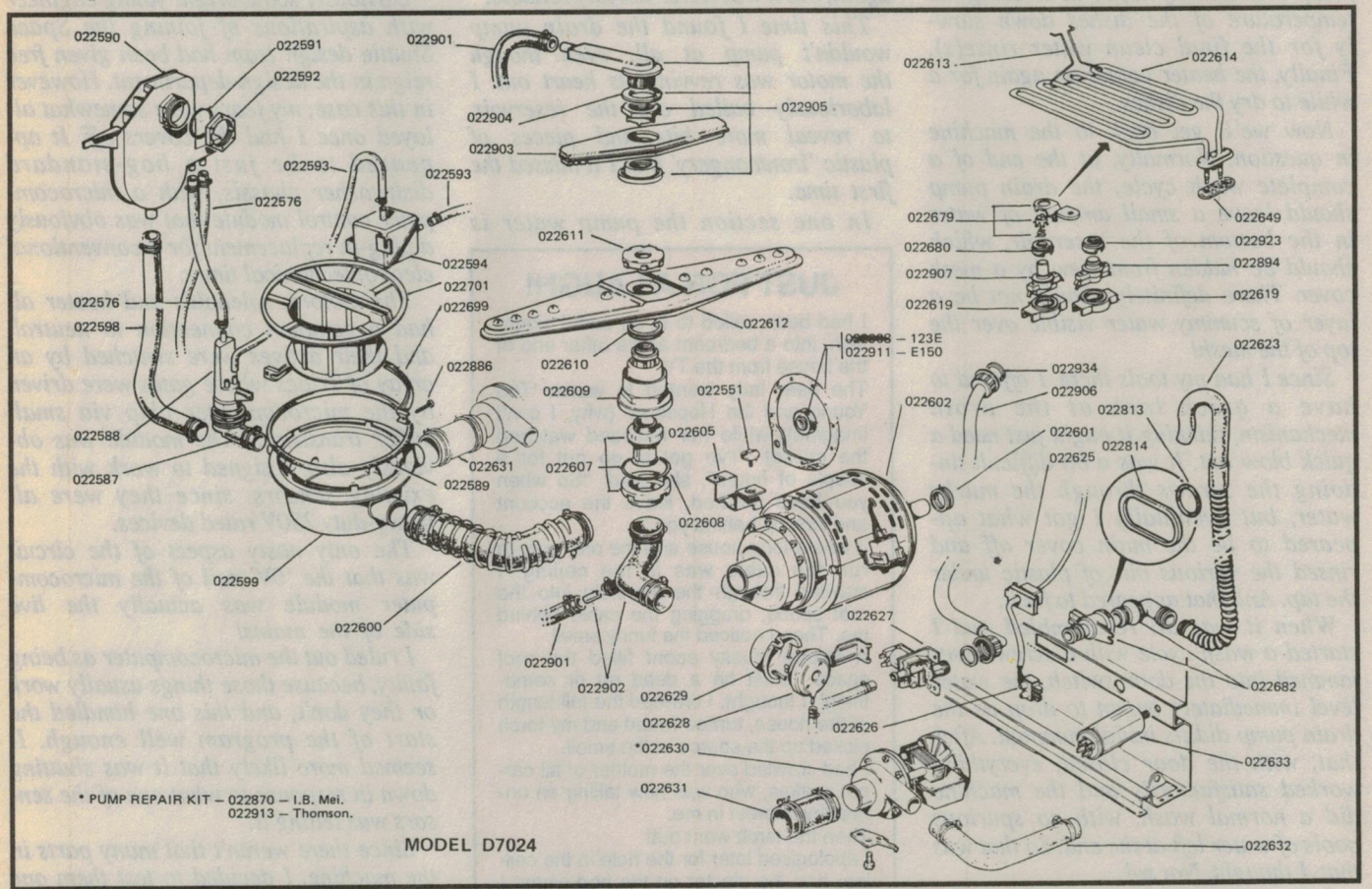
Someone once gave me one of those mugs that say 'ENSURE brain is engaged before putting mouth in gear.' I wish I could remember such sage advice at times like this. 'That shouldn't be like that,' I said, foolishly. Since many of you are probably not all that familiar with dishwashers, (as I used to be and wish I still was), perhaps I should take time out to briefly explain how they work, or at least, as I understand them to work.

Most dishwashers are constructed roughly along the lines of an electric oven. They have a swing-down waterproof door, roll-out racks (usually two) for the dishes, and a special basket for cutlery. The actual washing is done by a pair of rotating lawn-sprinkler-like contraptions that spray water at a fairly high pressure from above and below the dishes.

In the bottom there's a dish-shaped reservoir which usually holds about 10 litres of water. A solenoid-operated valve fills this several times from a dedicated cold water connection, and a drain pump driven by a small single-winding AC motor empties the used water at the end of each cycle.

A more powerful capacitor-start motor drives the wash pump that forces the water through the spray units. A heater element in the bottom (much like the rectangular ones found in ovens) heats the water during the wash cycle and also dries the dishes at the end.

A special non-foaming wash powder is



The sump/pump assembly for a typical dishwasher of the vintage described in our story. The bar-type spray head is in the centre of the diagram, with the wash pump motor below and to the right. The sump is left of centre and the drain pump at the lower right.

used, consisting of a mixture of strongly alkaline mineral salts. These wash much more effectively than soap or detergent, but are too corrosive for normal hand washing. The powder is placed in a special compartment which is opened by a solenoid at the appropriate time. Some machines also have another, similar compartment for 'rinse-aid' type powders. There are also various temperature and water level sensors.

A normal wash cycle is as follows: The drain pump runs for a short time to ensure the reservoir is emptied, then the tap solenoid refills it to a predetermined level. The wash pump then starts up to do a cold pre-rinse, mainly to dissolve any water-soluble substances that might interfere with the dishwasher powder.

The reservoir is then emptied and refilled with fresh water; the heater is turned on; the powder is released, and the wash pump starts the 'wash' cycle. The water is normally heated to about 60°C during this time.

After this, the drain pump and tap solenoid do a couple of partial pump-outs and refills, so as to bring the temperature of the dishes down slowly for the final clean water rinse(s). Finally, the heater comes on again for a while to dry the dishes.

Now we'll get back to the machine in question. Normally, at the end of a complete wash cycle, the drain pump should leave a small amount of water in the bottom of the reservoir, which should be hidden from view by a mesh cover. There definitely should not be a layer of scummy water visible over the top of the mesh!

Since I had my tools there, I offered to have a quick look at the drain mechanism, thinking it might just need a quick blow out. It was a bit difficult undoing the screws through the murky water, but eventually I got what appeared to be the main cover off and rinsed the various bits of plastic under the tap. And that appeared to fix it.

When it was all reassembled and I started a wash cycle with a screwdriver jammed into the door switch, the water level immediately began to drop as the drain pump did its initial pumpout. After that, with the door closed, everything worked satisfactorily and the machine did a normal wash, with no spurious pools of water left at the end. So that was that, I thought. Not so!

A few days later the woman was on my doorstep wondering if I could have another look at the machine. You guessed it — the thing wasn't working at all now!

'Never reliable...'

But this time she came clean and admitted that the thing had never worked properly in all the time she'd had it. It had had a new computer control unit and countless service calls until the warranty ran out. For a while she'd even given up persevering with it, and had done her washing up in the sink. Eventually somebody had got the thing going again, but it was never terribly reliable.

This time I found the drain pump wouldn't pump at all, even though the motor was revving its heart out. I laboriously bailed out the reservoir, to reveal more bits and pieces of plastic 'ironmongery' that I'd missed the first time.

In one section the pump water is forced through a slot barely big enough to admit a 10c piece — and in there was wedged a watermelon seed, with lots of other unidentifiable goop behind it. I cleaned and reassembled everything, tipped a bucket of water into the reservoir and started the wash cycle, and was relieved to see the water being pumped out, at a considerably faster rate than before.

Just to be on the safe side, though, I thought I'd better let it do a complete wash sequence, in case I'd put something back together wrongly. Just as well I did. The pump finished pumping, leaving the regulation amount of water in the reservoir, and then everything just stopped! No funny noises, no flashing lights (in fact no lights of any sort). It was just as if someone had switched the power off. Sigh!

(The account that follows only covers the main points of the ensuing battle; as is often the case, the real story was much more protracted and tedious).

I was dreading what I might find under the main covers of the machine — I still have nightmares about 'an all-electronic' washing machine I was once asked to 'have a look at'.

Obviously some bright young engineer with aspirations of joining the Space Shuttle design team had been given free reign in the design department. However in this case, my fears were somewhat allayed once I had the covers off. It appeared to be just a bog-standard dishwasher chassis, with a microcomputer control module that was obviously a plug-in replacement for a conventional electromechanical timer.

The motors, solenoids and heater all had a common connection to neutral, and their actives were switched by an array of Triacs whose gates were driven by the microcomputer chip via small buffer transistors. The module was obviously also designed to work with the existing sensors, since they were all heavy-duty 250V rated devices.

The only nasty aspect of the circuit was that the '0V' rail of the microcomputer module was actually the live side of the mains!

I ruled out the microcomputer as being faulty, because those things usually work or they don't, and this one handled the start of the program well enough. It seemed more likely that it was shutting down in response to what one of the sensors was telling it.

Since there weren't that many parts in the machine, I decided to test them one by one. I've made up a couple of 240V test leads with female spade connectors which are very useful for this sort of

Fault of the Month

Sanyo CPP3001 CTV
SYMPTOM: Set comes on in AV mode and cannot be changed to TV mode.
CURE: The TV/AV button had jammed in the AV position. This control is a momentary-action device and the fault should have prevented any action on the part of the microprocessor. However in this case it seems the set was able to lock into the AV mode and function relatively normally.

This information is supplied by courtesy of the Tasmanian Branch of The Electronics Technicians' Institute of Australia (TETIA). Contributions should be sent to J. Lawler, 16 Adina Street, Geilston Bay, Tasmania 7015.

JUST FOR A LAUGH!

I had been called to fit an aerial extension, into a bedroom at the other end of the house from the TV.
The dear lady wanted to watch 'The Young and the Hopeless' (why, I can't imagine!) while her husband watched the cricket. "I've got to go out for a couple of hours", she said. "So when you have finished, leave the account and lock up behind you."
It was a long house and the only way to run the cable was in the ceiling. I crawled through the manhole into the roof space, dragging the cable behind me. Then I noticed the funny smell.
A strong musky scent filled the roof space. 'Must be a dead rat or something', I thought. I crawled the full length of the house, turned round and my torch picked up the source of the smell.
I had crawled over the mother of all carpet snakes, who was now taking an unhealthy interest in me.
Then the torch went out!
I apologised later for the hole in the ceiling, and the plaster on the bed where I had landed...

Contributed by John Gill, of Lowood, Qld

work. They allow you to power up the various motors etc, from a safe distance!

First I checked the tap solenoid. Initially I thought it had shuffled off its mortal coil (Oops — sorry about that!) as it measured about 3000 ohms and didn't make much noise when I applied 240V. But with the hose reconnected, it admitted water whenever required. I've since learned that it's one of the new 'quiet' model solenoids. I don't know why they bother — the solenoid might be quieter, but the house plumbing still bangs just as enthusiastically whenever the valve shuts off!

Similarly, with 240V applied to the appropriate places, the wash pump roared to life; the powder release solenoid released and the heater heated.

That ruled out all the active components, leaving me with only the sensors. One of the problems I had was that I didn't know whether the various sensors were supposed to be normally open or normally closed, so I had to try to activate them. The temperature sensor I checked by putting on the stove, where it clicked when it reached 60°C, the critical temperature.

Water sensors?

That left the two water level sensors. These two devices I eventually found at the front of the dishwasher, under a suspiciously-easy-to-remove cover plate. They look like miniature car 'vacuum advance' diaphragm units, with plastic hoses following a long and tortuous path back to the main water reservoir. Each one had three spade connectors, presumably in a changeover switch configuration, although only two of each were used.

I'm not altogether sure of all the details, but presumably one detects the upper level, to prevent overfilling, while the other detects the lower level, to ensure that there's always some water left to prime the pump. When I pulled the hose off one unit, there was a distinct 'click' from inside. Bingo! I pulled out as much of the hose as I could and after a few seconds of my best James Morrison impersonation, there was a spluttering gurgle from inside the reservoir.

The two hoses connect to a small well, separate from the main cavity, with two funny S-bend-like contraptions that plug into individual slots in the well. Anyway, floating around in the now-murky water were what appeared to be small strips of onion! (The other hose was clear).

End of story? I wish it was!

I put it all back together and it did a faultless wash and dry cycle, and I thought I'd cured it. And so I had— for a while.

About a week later she was back on my doorstep. The fault wasn't exactly the same; this time it actually managed to refill the reservoir before the 'pre-wash' light started blinking and it would do no more. Oh well, at least I knew where everything was this time! I unscrewed the access panel on the front and gave the tubes another blowout and that seemed to fix it again.

I began to wonder if the problem might not simply be that the gauze reservoir cover was not seating properly, letting food scraps get into the pump mechanism. There's also a small solids trap, which is about the size and shape of a disposable coffee cup and fits into a hole in the gauze cover. Both filters were always spotlessly clean, and I'd assumed the lady had cleaned them after each wash.

But then she said she hardly ever cleaned them — it was never necessary. Eh!? Then I had a look at the small trap and realised that this could well be the cause of all her problems.

The trap is actually made in two sections — an inner removeable 'basket' designed to trap really large pieces of food, and an outer piece lined with a fine mesh.

The trouble was, the sides of the outer piece were covered with the mesh, but there was nothing on the bottom! Most of the goop would have no trouble whatsoever finding its way to the pump through there. I then assumed (wrongly as it turned out) that the problem all along had simply been that there was a part missing from the bottom of the trap.

I managed to fashion a suitable rubber seal from some two-part silicone rubber the lady had (it's actually for making hearing aid moulds, but it doesn't seem to mind the hostile environment). And that seemed to have fixed it, apart from one further small hiccup. Every now and then the machine would stop halfway through the final rinse cycle. Repeating the whole wash sequence (without powder) would usually overcome the problem, but it was quite annoying.

Reading the instruction manual (after all else failed), I found the problem. It says it's very important that the drain hose be raised at least 40cm above the floor level. Otherwise, the reservoir tends to get syphoned out during the wash and rinse cycles.

Most dishwashers are mounted under or near the kitchen sink, and the drain hose is fed into a hole just above the S-bend. As this is normally raised well above floor level the syphoning problem never occurs. In this case, however, there was no room under the sink, and she had it mounted on the other side of the kitchen, the hose passing through a hole in the floor.

Simple cure

I tied the hose up with a bit of hookup wire and that was that! It's provided a permanent cure, though I can't imagine why they couldn't have done that in the factory.

Continued on page 97

Moffat's Madhouse...

by TOM MOFFAT

What IS unemployment, really?

Not long ago, our Burglar's Dog jazz band was asked to play for a large construction company's 25th anniversary celebration at the Wrest Point Casino convention centre in Hobart. This was a big deal for us; undoubtedly the best venue in the state, an enormous sound system, 16 microphones, a stage that can rise up out of the floor. We had hit the peak!

But this function got off to a somewhat strange start. It opened with a prayer of thanksgiving. I've been to a lot of parties in my time, but this is the first one that started with a prayer, as in a church service. We, the band, had our own table where dinner and drinks were laid on when we weren't actually playing. When the prayers began we looked at each other in bewilderment. What had we got ourselves into?

Then we listened, and understood. These people were giving thanks to God, primarily for the fact that they all had jobs in a world where 'having a job' is becoming something of an oddity. And, since this was a company function, everyone in the room either had a job, or was married to someone who had a job. Except for the band, of course.

There are eight of *us*, all male, ranging in age from 35 to 50 or so. Maybe we are a more representative sample of society in general. If you define 'having a job' as an arrangement where you work full-time for somebody else who regularly pays you a fixed amount of money, then three of the eight of us have jobs. A fourth person works part-time; he has half a job.

Three of us (including me) are 'self-employed'. This means we are now freelancing in fields where we formerly held 'proper' jobs. None of us entered this arrangement voluntarily. We were out- placed, retrenched, made redundant. All of these are euphemisms for 'becoming unemployed'. The eighth fellow is only with us temporarily, but I know he doesn't hold a 'proper' job.

Now, as far as I know, not one band member is in receipt of the dole, or registered with the CES. So they are not part of Australia's unemployment statistics. Yet only three of the eight can be considered 'employed' under the normally accepted definition. As for the rest of us, we hit the ground hard but we came up running. We have MADE jobs for ourselves.

Trouble is, our home-made jobs are a far cry from what we used to have. Back in the good old days, we could work 35 or 38 hours over five days. Our wives stayed home, cooked, took care of the kids, played tennis on Wednesday mornings. On weekends we could rest, all of us, and do fun things with our families.

Now there is no such thing as 'time off'. We are on duty all the time. To produce an income anywhere *near* what we got with proper jobs, we have to work in the days, and in the evenings, and at weekends. Sometimes we make ends meet, sometimes not; you never know if work will be there. And our wives have to work as well, although nowadays there seem to be more 'proper' jobs for women.

I suspect many of you reading this may find it all too familiar. But it's always good to know you're not alone, and more importantly, what has happened to you is probably not your fault. It's just the system as it works today.

Perhaps my own experience will enlighten. As many of you know, I spent the first 25 years of my life in the USA, and from the time I became old enough to work I was never without a job. I did some pretty satisfying things, what with all my missile test range postings to exotic places. And I loved working for the Bell Telephone Company; it was a never-ending adventure of climbing mountains, hooning around in Sno-cats and bulldozers, and of course, playing radios. Even during school and university, there was always a temporary job whenever I wanted one.

When I threw all that aside and migrated to Australia in 1968 there were jobs for everyone, and I had three offers in the first week of searching. I chose television, as an audio operator and later journalist with GTV-9 in Melbourne. Then came the move to Tasmania, for no reason other than the place appealed to me. I ran a successful two-way radio business for awhile, and then got the television bug again. That resulted in another six years in news at Tas-TV in Hobart.

Lure of high tech

But then I was lured into high-technology again; robots and computers and, in the final couple of years, designing weather- fax machines. That job gave me six years of designing pretty much anything that came into my head, and having a company behind me to market the results. It was fine, until money got tight and sales fell, and one day the boss came into the lab and said:

"Well, Tom, you can keep working here if you like, but we won't be able to pay you any more". It was a rather gentle way to put it, but the fact remained that I had just been sacked, for the first time in my life. The company closed its doors the next day.

My sacking came just before lunchtime, and I headed out the door and into the street. It seemed very hot and I slumped aginst a wall. I really thought I was going to pass out. But I finally got myself together and started walking through the city. And the first person I met was a friend who was an ABC radio announcer. I told him what had happened, and then began worrying that he would go back on air that afternoon and say "Guess what, Hobart! Tom Moffat's been sacked!" I was so very ashamed.

I kept wandering for a long time, and eventually got up the nerve to go home and tell my wife I'd been sacked. This was the hardest part; yesterday I was the provider for my family, today I was the newest resident of the scrap heap. Quite useless, and now dependent upon the good graces of my wife to support me and my family. This is the hardest part. Not the loss of income as such, but the shame.

I managed to line up some casual work, mostly creating PCB designs from other people's circuits, and eventually I was approached by a marine radio company which knew of my work in weatherfax and wanted me to design a system for them. They even flew me to Sydney to look over their operation, and I thought I was surely back in proper employment again. I proudly made some prototypes of a really snazzy wefax receiver, but then that company bit the dust before the design ever went into production. So it was back to the scrap heap for Tom, for a second time.

Well, I wasn't going to put up with that so I started doing magazine work with a vengeance — mostly for Federal Publishing, who I'd been freelancing for off and on for many years. They have given me lots of support, for which I am eternally thankful. And part of that unused weatherfax design eventually surfaced in *EA* as the Listening Post II.

All this talk about me might seem a trifle self-indulgent, but I've written it to show those of you who have suffered the same fate that it happens to other people as well as you. And it is sad to say that others who are now employed are in the firing line too.

The very next night after that party at the Casino, I went along to the local pub for a drink with my neighbors. I hadn't seen some of them in a long time, and I was saddened to hear that a couple of them were about to 'take redundancies'. This is the system by which employees are paid a lump sum to 'voluntarily' vacate their jobs. One of these fellows is a much-respected electronics teacher of some 25 years standing. Now, in the name of economic rationalization, he is being given the heave-ho.

The bait in 'taking a redundancy' is a cash payout of perhaps $150,000 for a long-standing government employee. The idea is a kind of early retirement, but people taking redundancies are mostly in their 40's, sometimes with kids to support or even to put through university by this time. That's a lot of years to go, and a lot of expense, and $150,000 will disappear fairly smartly.

What about investing it? Well, that's pretty dicey too nowadays. When we were first married my wife and I bought some shares in a well-known construction company. These were supposed to grow and grow in value, and be worth a lot of money by the time I reached retirement. Well, I never did reach retirement, and the building company has now gone broke. The shares are said to have a 'negative value', whatever that means.

So here we have ex-employees, mostly men over 40, with $150,000 in their pockets. It is unlikely any of them will ever be 'employed' again. Some will make their own jobs, but others will simply plug along until the redundancy payout is gone. Then what? What happens when they hit 55, broke?

There is no easy solution. The latest scheme, as I write this, is a special government tax on those who have jobs, to help support those who don't have jobs. But the way the system works at the moment, people with jobs will decrease, and those without jobs will increase. Politicians tell us 'the recession (depression) is almost over', but what they don't tell us is that many of the jobs lost over the past few years are gone forever.

As for the politicians themselves, and many of their underlings, it seems they have built up an immunity to unemployment. Just last night I was listening to a contact on one of the amateur radio bands between a station in Sydney and another in Canberra. The Sydney operator was making a trip to Canberra during the following week, and wanted to know the frequencies of two-metre repeaters where he might make a contact. The answer was 'don't expect to find anybody on the air during the day. We all go to work in Canberra, unlike the rest of Australia'. I found that remark rather cruel.

Technology to blame?

Sadly to say, the very thing celebrated by magazines like this one — technology — is mostly to blame for our lack of jobs. We used to see these articles about how this robot or that computer is going to relieve the drudgery of routine menial jobs. But what has happened is that they haven't removed the drudgery; they've removed the jobs altogether.

Take banking: 15 years ago, behind the scenes in a bank, you would see people going through cheques, sorting, recording, taking money out of one account and putting it into another. Now most of the people are gone; computers rule. Even bank tellers are machines, more and more often.

Same in insurance companies: people who used to be known as 'clerks' are gone, replaced by computers. And on assembly lines, whole factories are empty as robots build things, under the control of computers.

Only this week news leaked out that there are to be massive redundancies (sackings) within the State Library of Tasmania. The people who used to handle those little 3" x 5" index cards now find their functions taken over by computers. Word has it that the staff of one library in a provincial city is to be decreased from 30 down to eight.

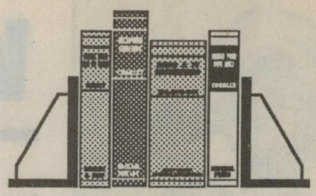
The new technology is of course welcomed by governments, as well as the proprietors of the businesses it serves. But they shouldn't really be criticised; if the technology is there, it would be irresponsible to their shareholders if businesses didn't use it. Without the ability to sack expensive people and replace them with cheap computers, many more businesses would have gone to the wall by now.

But when things finally turn around, will the bosses sack the computers and give the humans their jobs back? Not on your nelly! Jobs given to computers are theirs forever. What we have here, then, is a major dilemma which MUST somehow be solved. I wouldn't have any idea how we're going to get out of this mess. Do you?

I don't enjoy writing columns like this, with such a negative theme. But it does set out problems, for which we MUST find a solution.

There was a ray of hope this morning, when I spoke with another technical teacher, this time in carpentry. He told me that rather than being offered redundancies, his lot was being consolidated into a new 'Centre of Excellence' in Hobart. This meant, for him, moving the family home. But it also indicated that there is a strong future for carpenters and builders — people who have enormous skills in their own two hands which, hopefully, won't be duplicated by robots or computers for a long, long time. ❖

NEW BOOKS



Audio technology

AUDIO & HI-FI HANDBOOK, edited by Ian R. Sinclair. Published by Newnes, 1993. Hard cover, 240 x 160mm, 820 pages. ISBN 0-7506-0932-X. Recommended retail price $115.95.

This new edition expands the aim of the previous version, the *Audio Electronics Reference Book*, to present as wide a perspective as possible of high quality sound reproduction. This includes reproduction under adverse circumstances (PA and in- car), from less conventional sources (such as synthesizers), and with regard to the whole technology from studio to ear.

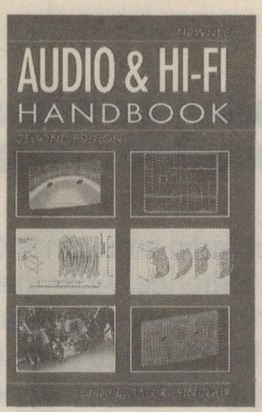
The book starts at the very beginning with the physics of sound and acoustics, then looks at various recording methods like CDs, LPs and tape, and noise reduction methods like the various Dolby systems (from 'A' to 'S'). There is a strong emphasis on digital audio, as you would expect in any modern publication.

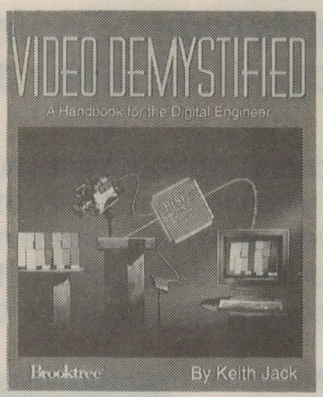
The electronics of audio systems is next. This includes the workings of tuners and receivers, of pre-amplifiers, voltage and power amplifiers, and loudspeakers and headphones. This treatment is quite detailed, looking at bipolar and CMOS transistors, MOSFETs and ICs. There is even a chapter on cables and connectors, raising the question of subjective quality which cannot be evaluated by scientific measurement.

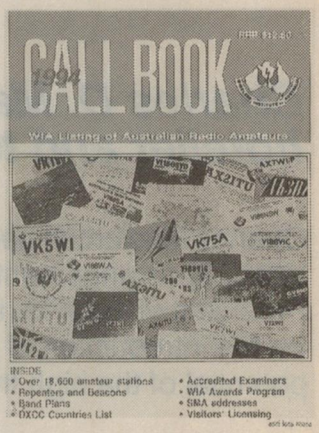
The methods of artificial sound synthesis are also treated. This is very relevant, as many sounds that we hear today have their origins in electronic instruments. The chapter includes the relationship between electronic music making and computers, along with the MIDI and MSX communications systems.

The scope of the book is enormous — which tends to limit the depth of treatment. For someone new to the areas treated, or with a superficial knowledge only, then the book is a very useful introduction. But someone seeking a thorough, in-depth treatment may be disappointed.

The review copy came from Butterworth-Heinemann, PO Box 345, North Ryde 2113. It should be available from technical bookshops. (P.M.)







Digital video

VIDEO DEMYSTIFIED: A Handbook for the Digital Engineer, by Keith Jack. Published by Brooktree Corporation, 1993. Soft covers, 235 x 188mm, 435 pages. RRP $59.95.

Traditionally a bastion of specialised high-level analog expertise, the field of video is rapidly moving into the digital domain — not only in the professional broadcasting and recording area, but of course in the 'multimedia computer' and consumer electronics areas as well.

This book seems to be aimed at providing not just a solid introduction to this conjunction of video and computer technology, but a working reference manual as well. The author is a senior engineer at Brooktree, which is of course one of the leading firms in this area.

The coverage seems to be very thorough, beginning with basic colour video system concepts and moving through digital encoding and decoding, digital composite and component video, digital video processing and compression/decompression systems. Each area is covered to a satisfying depth, and for those who start to get lost in the jargon (such as '4:2:2 orthogonal sampling' and 'YCrCb coding ranges'), there's a 28-page glossary at the back. Each chapter also includes a list of references for further reading.

In short, then, a very informative reference on an area of electronics which is growing dramatically in importance. For the price quoted, it seems excellent value for money. The review copy came from Dick Smith Electronics, Cat. No. B-6120. (J.R.)

For radio amateurs

AUSTRALIAN CALL BOOK 1994, published by the Wireless Institute of Australia. Soft cover, 270 x 210mm, 152 pages. RRP $12.50.

This latest edition of the Call Book lists all Australian radio amateur callsigns on issue as at 31st August 1993. Not *all* names are necessarily listed, as some licensees have requested that theirs not be published. The list has been compiled from WIA and Spectrum Management Agency (SMA) records.

The publication is not just a list of amateur callsigns, but also contains a comprehensive Australian repeater directory, including guidelines for establishing and using repeaters. It also contains a complete set of Australian Band Plans and their guiding principles.

For those interested in becoming amateurs, the booklet supplies all necessary information — licensing and fees, authorised frequency bands, types of emission, erecting antenna masts, etc., plus who can become an amateur, how to become one, and the advantages of belonging to the WIA.

For $12.50 the booklet provides a lot of useful and necessary information for anyone involved in amateur radio. Our review copy came from Dick Smith Electronics (Cat. No. B-2336). (P.M.) ❖

When I Think Back...

by Neville Williams

Charles D. Maclurcan: Engineer, businessman, hotelier and top Australian amateur broadcaster — 1

Charles Maclurcan became involved in amateur radio around 1910, and continued to operate during WW1 by arrangement with the Department of Defence. After the war, as Vice-President and then President of the WIA, he helped revitalise the movement and, as a leading amateur, to set the scene for the introduction of public broadcasting. In the mid 1920's, he also did much to demonstrate the potential of the high frequency spectrum for long distance, low-power communication.

I never met Charles Maclurcan, largely because he was a generation ahead of me and was making a name for himself in wireless/radio before I was born. By the time I became even aware of wireless, licenced broadcasting stations had appeared on air, giving rise to many other personalities to compete for the headlines.

During the 1930's, when I became actively involved in the industry, Charles Maclurcan was fully pre-occupied with family business affairs, and our paths never crossed. When his name did crop up in trade circles, he was commonly remembered as a former amateur broadcaster, whose family owned Sydney's 'Wentworth' hotel.

Looking back, the definition probably said as much about the rest of us as it did about Maclurcan himself. The average 1930's-style wireless enthusiast didn't have much interest in trendy hotels or move in social circles. We had simply to manage on a (very) few quid a week!

An unfair remark? "Not really", according to *EA*'s former amateur radio correspondent, Pierce Healy VK2APQ. "That's the way it was." It — the contrast — suggests a logical starting point for the Charles Maclurcan story.

His mother was Hannah Phillips, born in 1861 to a couple who owned a hotel in Tambaroora — one of six 'pubs' in a small gold-mining shanty town between Mudgee and Sofala, in NSW, west of the Great Dividing Range. Charles Maclurcan's eldest son Donald adds that there were also three churches in the town, "which probably reflected the priorities" of the 400-odd residents. When the Phillips family subsequently moved to Toowoombah in Queensland, a teenage Hannah took over the management of her father's Club Hotel. The move proved to be a stepping stone to the Criterion and Queen's Hotels in Townsville, Qld. She married a banker, Robert Wigram, in 1880 and bore him two daughters. When he died a few years later, Hannah emerged as the sole owner of the Queens' Hotel.

Fig.1: From 'Wireless Weekly' for September 22, 1922, Charles Maclurcan at the height of his popularity as an amateur broadcaster from his station 2CM at Strathfield.

Maclurcan dynasty

In 1887, she married Samuel Donald Maclurcan, a master mariner (retired) from the British India Shipping Line, soon bearing him a daughter and, in 1890, a son — Charles Dansie. Behind the two children was an unlikely heritage of an ultra-Australian outback mining community and a pukka British family with formal links to education, the Church, Army and Navy.

In 1897, Hannah produced a very successful *Mrs Maclurcan's Cookery Book* which served as Australia's 'culinary bible' for the next half-century. Meanwhile, her son Charles was being educated at Downes Grammar School in Toowoomba.

1901 saw the family move south to Sydney, to take over the lease of the Wentworth House Family Hotel (alternatively known as Mrs Hayes' Boarding House) in Lang St, facing Lang Park, near the Rocks end of the City. Donald Maclurcan died two years later, leaving Hannah as the sole owner.

(Around 1942, as its then Managing Director, Charles Maclurcan was to prepare an illustrated history of the Wentworth site, detailing the acquisition of neighbouring properties and the nine-odd owners from 1855. It covered also the upgrading of accommodation

and the addition of a magnificent 1000-couple ballroom. While interesting in its own right, and for glimpses of old Sydney, I have included here only as much of the story as is relevant to the present narrative.)

Damaged by fire in 1911, the premises were restored and substantially enlarged. In 1912, the refurbished establishment was re-registered as the Wentworth Hotel Ltd, and its owner/manager Hannah Maclurcan set about transforming it into a major social, cultural and entertainment centre — an ambition that reached fulfillment in the 1920's. 1925 saw the launch of 'The Wentworth' house magazine 'with articles on art, literature, music, stage and screen... fiction... the great outdoors... and national sports'. As a quality journal, it was to be served by hand-picked writers and photographers.

Meanwhile, young Charles had been apprenticed as an electrical engineer at the nearby Clarence Street power station, where DC (direct current) was generated to power the trams and also supply 240V to the central business district. (This area was still on DC when I commenced work at Reliance Radio in nearby York Street, in the early 1930's).

Charles steps out

Initially, the power station had been operated by the Empire Electric Light Company, but was subsequently taken over by the City Council. His formal training complete, Charles Maclurcan took the opportunity to offer consumers personalised 24-hour, seven-day electrical service and maintenance for a monthly fee. The novel venture earned him enough to cover a trip to England, and to found a motor car importing business: Messrs Maclurcan & Lane.

While Charles could hardly have failed to acquire business acumen from his parents, his technical training had exposed him to workshop practice and the lure of electricity. It also led indirectly to an interest in wireless communication — which was based, initially, more on electrical concepts than what we now define as 'electronics' (Fig.2).

In an interview titled 'A Pioneer Looks Back', published in *Wireless Weekly* for December 8, 1922 he explained, with a characteristic element of whimsical humour:

'My wireless activities date back to 1908 or '09. There were very few experimenters in those days. The then-leaders were Chas. P. Bartholemew, rightly called 'the Father of Wireless', Mr F. Leverrier, and Mr Jack Pike.'

'I might never have taken it up, only Jack Pike and I were both keen on the same girl and he seemed to be getting more of her attention than I thought to be warranted. I therefore decided to set about making noises like a spark gap, to sidetrack her.

'I didn't succeed but, anyway, she married someone else, so it turned out alright.'

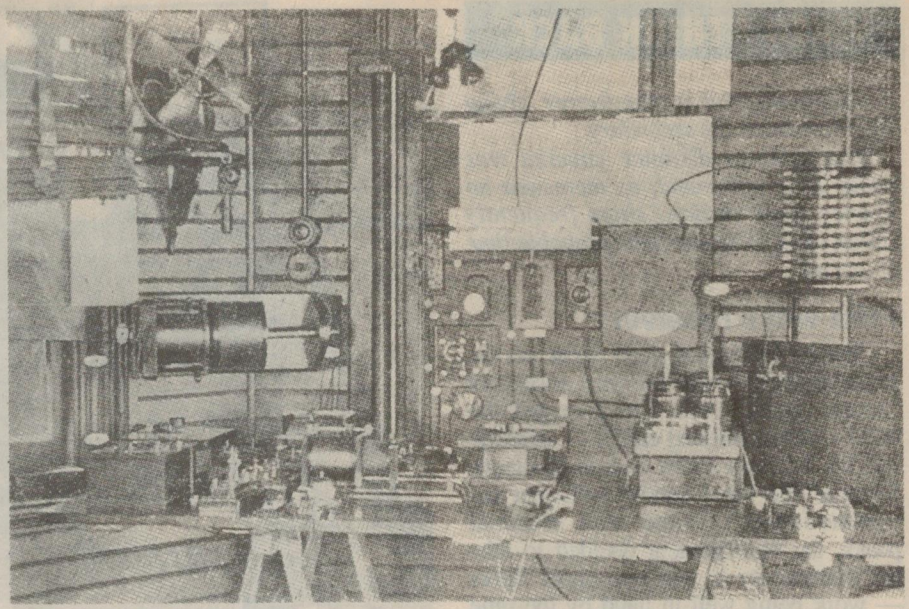


Fig.2: This picture was deemed to be historic when published on the cover of 'Wireless Weekly' for November 24, 1922. It shows portion of the spark equipment operated by Charles Maclurcan in the Wentworth Hotel. It was reputed to create fearsome sparks and alarming noises!

Wireless for all to see

Be that as it may, in 1910 young Charles sought the permission of his mother to have two wireless masts erected on the roof of the hotel, one 76ft (23m) tall and the other about half that height. According to Charles Maclurcan, the installation cost £75 — equivalent to several months' wages in those days.

In a city with few tall buildings (at the time), the two masts, with an inverted-L 'wireless' aerial strung between them became a landmark and a conversation piece. The aforementioned nexus had been established between this new-fangled 'wireless', a young engineer Charles Maclurcan and the up-and-coming Wentworth Hotel.

Characteristically, he wasted no time. Granted an experimenter's licence, he set about building and installing a spark wireless system, learning Morse code and, in 1911, communicating with ships moving in and out of Sydney Harbour.

Central to the equipment, according to the same 1922 *Wireless Weekly* article, was a huge 12-inch (30cm) spark coil and a helix which, between them, could develop such fearsome sparks and alarming noises that visitors to the wireless room were often glad to be excused!

In the interview for the above article, Charles Maclurcan described the installation as follows:

'The first receiver consisted of the usual loose coupler arrangement, with a Pericon detector, and great was the excitement when, some time later, a Suva station was copied.'

'The first transmitter consisted of a 10-inch spark coil with Leyden jar condensers. When the key was pressed, things happened — everywhere.'

'Later, the transmitter was altered to a 1-1/2kW rotary spark set (non-

Music in the Air

Mr Maclurcan's next Sunday's concert will commence at 7.30 and will include the following Pathe records:
Fox Trot — 'Say it with Music'.
Soprano — 'La Forza dei Destino', Claudio Muzic.
Hawaiian Guitar — 'Mahaina Malamalaiama'.
Nursery Rhymes.
Whistling — 'Bita Raptures'.
Tenor — 'Vainement me bien Ainee'. Mr Vaquet
Piano Solo — 'Maiden's Wish'. Chopin-Liszt
Fox Trot — 'I Call You Sunshine'
Baritone — From the 'Little White House'
'The Night Nursery'
'The Smoking Room' (Edgar Coyle)
Hawaiian Guitar — 'Sweet Lei Lehua'.
Banjo — 'Linfanta' and
By request, 'Soldier's Chorus' (Faust)
(From 'Wireless Weekly', August 11, 1922)

synchronous) and a transformer giving 10,000 volts on the secondary.

'The furthest distance covered was about 2000 miles and, as there was no Sydney land station, ships frequently called LMX to report their probable time of arrival'.

First valve receiver

Charles Maclurcan then went on the explain that, while he was absent in Europe during 1911, fire damaged the hotel — as mentioned earlier — destroying his wireless room and its contents. Because the hotel lacked sufficient accommodation to cope with seasonal peaks, the management decided to take the opportunity to add two upper floors — work being well in hand by the time he returned. I quote:

'The aerial once more became a familiar landmark, in 1912, as an unbrella type. It was then 49ft (12m) higher up in the world.'

'The set then consisted of a Clapp Eastham, 1/2kW Hytone transmitter plus what was, I think, the first valve receiver used in Australia.'

'It used one of the original De Forest audions, pear-shaped, with a tiny flat plate and grid. It 'blue-glowed' on the slightest provocation but, nevertheless, was a great improvement on the crystal.'

'The second one of these valves was imported for Mr Bartholemew who, by the way, now has the transmitter of this station, retired peacefully in his workshop — 'stuffed', as it were (for display) on his mantelpiece!'

Charles Maclurcan rounded off his 1922 reflections with an observation that the photograph (Fig.2) shows the 'enormous amount of gear' once required, 'as compared with an up-to-date valve station. The idea then was: whatever gear you possess, work it all in'.

What comes through overall is that Charles Maclurcan borrowed, built, bought, modified and used an endless variety of equipment during his career, and the many published pictures of his 'rig' apply only to the period when they were taken.

With the outbreak of war in 1914, he was required, as an experimenter, to cease operation, dismantle his equipment and take down his masts. The first two presented no great difficulty, but taking down the masts certainly did. If the authorities wanted them removed, he insisted, they would have to accept the responsibility and expense of lowering them and re-erecting them after the war!

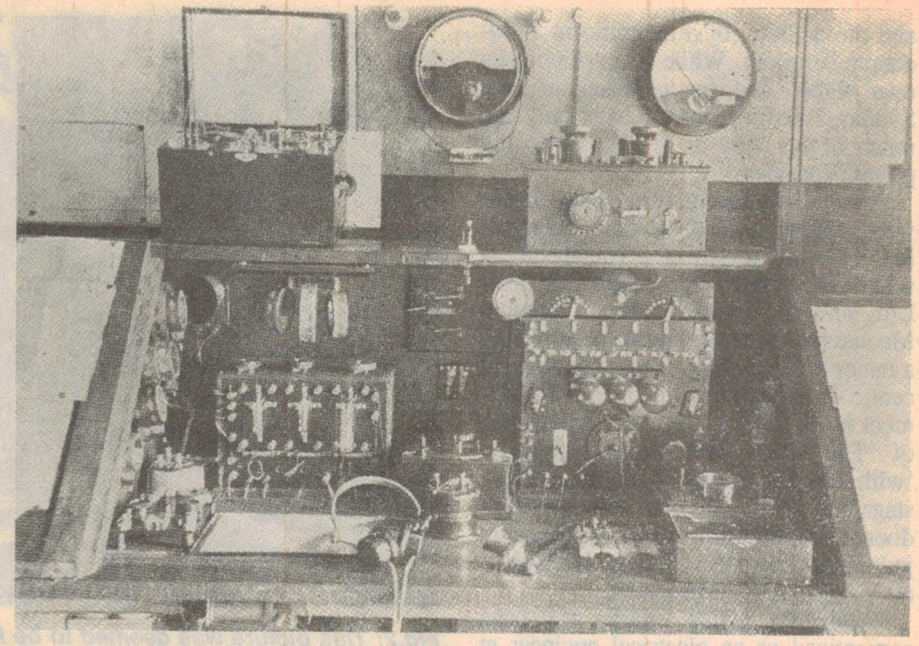


Fig.3: Intended to contrast with Fig.2, 'Wireless Weekly' published this picture on their cover for December 1, 1922, showing the 'much more modern' 2CM transmitter then in use at Strathfield.

According to his son Donald, the Defence authorities became convinced, during the exchange, that Charles Maclurcan could communicate with ships over greater distances than they could themselves, and they accordingly 'bent the rules' on his account. He was given the honorary rank of 'Major', on the understanding that he would work with and for them for the duration of hostilities.

It was the first of at least three occasions when, as an experimenter, he received special treatment by the Government. Indeed, adds Donald, he was so respected in official circles that his opinions were often sought alongside those of Ernest Fisk.

Man of many parts

In conversation, Charles Maclurcan's two surviving sons, Donald and Robert (the second, Douglas is deceased) were anxious to make the point that their father was 'a man of many parts', with interests way beyond his traditional reputation as a wireless/radio pioneer of the pre-broadcasting era. It so happens that such was the central theme in a profile of a retired Charles Maclurcan published in *People* magazine for April 23, 1952.

Under the heading 'The Original Ham', the article was subtitled 'Master of many things, Charles Maclurcan who gained fame as a radio amateur and hotelier now says he's a retired bloke. It goes on to describe:

A life of immense speed and diversity in which he has been a garage proprietor, car importer, electrical engineer, model maker, radio mechanic and operator, philatelist, figure skater, hotel proprietor, racing motor cyclist, historian and businessman.

He has always been a profound negation of the old adage of doing one thing well, since he has, without exception, made a success of everything he has ever done.

Physically slim and wiry, if somewhat stooped, one of his favourite haunts as a youth was the old 'Glaciarium' ice skating rink, near Sydney's Central Station. *People* magazine carries a picture of him at age 19, when he had just earned the title of NSW Figure Skating Champion. He also headed the Glaciarium Honours List as the first man to pass the Bronze, Silver and Gold Medal International Ice Figure Skating Tests.

Mr Maclurcan's Puzzle

A rope is passed over a pulley. It has a weight at one end and a monkey at the other. There is the same length of rope on either side and equilibrium is maintained. The rope weighs four ounces per foot. The age of the monkey and of the monkey's mother together total four years. The weight of the monkey is as many pounds as the monkey's mother is years old. The monkey's mother was twice as old as the monkey was when the monkey's mother was half as old as the monkey will be when the monkey is three times as old as the monkey. The weight of the rope and the weight at the end was half as much again as the difference in weight between the weight of the weight and the weight of the monkey. Now what was the weight of the rope?

When the 'Glaci' was facing closure and demolition, *The Sun* newspaper (February 20, 1956) carried a one-page article about the old building which had been the home of ice skating, West's Pictures and 'Cyclorama'. Featured prominently was the name of Charles Maclurcan — known in other circles as a wireless pioneer and the son of parents who owned the Wentworth Hotel.

On roller skates or fresh snow, he was only slightly less at home and was one of the pioneers of the Kosciusko snow fields, having a run named after him.

Man in a hurry

Another picture in *People* magazine shows a debonair young Charles at the wheel of his mother's 1911 model Renault Landaulette — a motorised hard-top coach, if ever there was one. This was at a time when other motorists were glad enough to have a fabric hood, with or without celluloid side-curtains! *People* notes that driving licences were not required when Charles first took the wheel, and that he still held the same serial number (in 1952) as he was allocated when they were ultimately issued: No.139. In that same Renault, he had the doubtful distinction of qualifying for a speeding 'ticket' while 'charging around' the streets near Circular Quay. Lacking a car, the police timed him between passes and calculated his speed as 24mph.

The magistrate was horrified. "Great Scott", he thundered, "That's the speed of an express train!" The offender was fined £4 ($8.00) with costs.

On another occasion, Charles decided to test his skill against other motor cycle enthusiasts on a dirt track. He was leading the pack when the drive belt flew off its pulley, causing him to crash heavily. Other machines went over him, but he laughed it off on the grounds that, having 'hit the boards' previously from ice skates, roller skates, skis and toboggans, as usual, he 'hadn't been hurt'!

Although the Maclurcan family car was a Renault, Charles Maclurcan held the agency for an English friction-drive car, the GWK. Intrigued by his claim that its running costs were 1.5 pence (1.5c approx) per mile, a wholesale firm offered to buy two of them if Maclurcan would operate them on their behalf for 2.0 pence per mile. He accepted the unique deal, which operated for several years — apparently to the satisfaction of both parties.

Fig.4: Erected in Maclurcan's backyard in Strathfield and as pictured in 'Wireless Weekly', this was one of the aerials in use at 2CM in October 1923. Other published pictures show two 80ft masts in the vacant allotment next door.

Fun lover though he may have been, there was another side to Charles Maclurcan's nature — a love of machine tools and precision workmanship. With access to his own workshop at Maclurcan & Lane, this was most apparent in the impressive collection of hand-made models which he had produced over the years. To quote from the *People* profile:

During his model-building days, Maclurcan assembled a fine collection of steam, clockwork and electrically driven machines such as scale locomotives, freighters, yachts and stationary engines.

His most ambitious and spectacular model was that of the old battleship 'HMS Lord Nelson', 4ft 6in (1.37m) long, which was remotely controlled by radio. It never failed to create a sensation when it churned across Centennial Park pond, wheeling, stopping and starting as though equipped with a mind of its own'.

His son Robert says that, although he never saw them personally, his father had installed model railway tracks on the roof of the Wentworth, as well as the wireless shack and aerial!

Radio post-war

At the close of World War I, the Government withdrew its restrictions on private radio, returned impounded equipment and re-issued experimenter's licences. But things had changed. While shipboard operators carried right on with their spark telegraphy, the future obviously belonged to valve-based equipment and telephony — the transmission and reception of speech and/or music.

Having married Winifred Kenna of Homebush (then a western fringe suburb of Sydney), Charles Maclurcan set up his family home at nearby Strathfield. Here they were to raise three sons: Donald, Douglas and Robert, the lastnamed born in 1920. Douglas, now deceased, became a radio engineer; Donald and Robert, both architects, helped in the preparation of this article.

At Strathfield, their father set up masts which, in the suburban landscape, became no less landmarks than those on top of the Wentworth. Two of them were in an adjacent vacant allotment, each 80ft (24m) high and 100ft (30m) apart.

He also set about building a valve-based telephony transmitter, which was housed in his 'ham shack' — along one wall of the family garage (Fig.3). For good measure, he later became the local agent for British Cossor radio valves and other wireless 'apparatus'.

In 1921, using a 50-watt transmitter on a 20-metre wavelength, he sent a message to His Majesty King George V from the wireless experimenters of Australia. In terms of technology, it was several years ahead of its time.

With his initials as his callsign, 2CM, he began broadcasting speech and music from his home at Strathfield, during 1921 - 22, for about 90 minutes each Sunday night. According to his son Robert, his licence to broadcast was the very first granted in Australia — written in longhand and signed by the then Prime Minister, 'Billy' Hughes, himself a wireless supporter if not an enthusiast.

Wireless Weekly for November 24, 1922 advises listeners to 'Listen for 2CM

WHEN I THINK BACK

on a wavelength of 1400 metres' (i.e., 214kHz or 'long wave'). Maclurcan later calculated that the broadcasts had gained an audience of about 5000 and, when he took time off for his annual vacation to Kosiusco, he was inundated with letters inquiring where had he been! As such, he could well claim to have been the first public broadcaster in Australia — and one of the very few in the world.

Wireless Weekly for December 8, 1922 carried a typical listener's letter directed to 2CM from a Mr H. Hinks of Mulgoa — nowadays accessible enough to the south-west of Sydney but, in those days, very much 'out in the the sticks':

Dear Sir,

I am writing to tell you that I heard your concert last night on a hand-made crystal set, using a pair of Brown's phones. The lady's voice came in very clear, also the steel guitar, of which I never missed a beat.

I have an aerial 600ft (180m) long and about 80ft (24m) up at the highest point, using twisted wire of 7/20 gauge.

I do not think it's a bad performance for a crystal, as I am about 40 miles from the transmitter. I might add that my call number is 2IS.

Charles Maclurcan's response to the letter was that, the best of his knowledge, Mr Hinks' reception of 2CM over 40 miles (60km) could be a record for a crystal set. But a 600ft wire, 80ft above ground... If, in 1994, I can borrow and adapt a phrase from Crocodile Dundee: "THAT'S an aerial!"

Soloist with 'cold feet'!

Maclurcan's son Robert related how, on one memorable occasion, Josie Melville visited the Strathfield 'studio' with the idea of presenting a couple of songs from the musical *Sally*, in which she was starring. When told that the audience on the night would approximate 5000, scattered in living rooms around the city, the soloist panicked and 'couldn't sing a note'. When calm was restored, she finally sang 'Look for the Silver Lining' and 'You can't Keep a Good Girl Down'!

Charles Maclurcan rounded it off with a request for listeners to write in, expressing their appreciation. About 2000 letters turned up within the next few days.

What happened to the other 3000? Said Charles: 'Maybe they didn't want to let on that they'd been listening without a licence'!

An accompanying panel lists the music offered during a typical Sunday evening broadcast from 2CM — comprising 78rpm records played on a spring-driven phonograph, fronted by a carbon microphone. To generations raised in a climate of hifi discs and tapes, and 24-hour radio stations, a program of three-to-four-minute shellac pressings would seem to be a non-event. In 1922, however, music for the average family was limited to hymns in church, an occasional concert, a family get-together, a music box or a dozen-odd tired 78's and a phonograph!

Nor was it just a matter of variety in musical fare. Per medium of wireless, new and refreshing personalities had gained access to the home with a different line of patter and snippets of news and information.

In the case of Charles Maclurcan, he was not without a sense of humour, albeit of the 1920's vintage. Conscious that enthusiasts were tending to take too seriously minor details of his equipment, he dreamed up a way of making a point — as he thought.

Toilet humour!

In the dead of night, he lowered his own aerial, disconnected the lead-in from the horizontal wire and reconnected them through a polished copper float ball, as used in toilet cisterns. Next morning, 2CM's latest 'refinement' was there for all to see. But nobody laughed. In no time at all, experimenters' aerial systems all around Sydney sprouted similar shiny copper balls, giving rise to earnest discussions as to how, or whether they worked!

People also told the story of how, on one occasion, Maclurcan rounded off his Sunday evening broadcast with a gimmick announcement:

The next two items will be:

'She sat in the sink and sunk!' and...

'It's not the cough that carries you off, but the coff-in they carry you off-in!'

It was apparently too much for a portly gentleman in nearby Lidcombe. With a huge guffaw, he flung himself back in his chair, earphones and all — spilling himself onto the floor and dragging his receiver after him in a mangled mess.

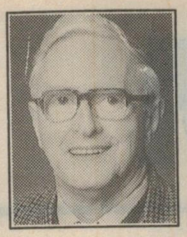
Again, *Wireless Weekly* for September 8, 1922 published a word puzzle which Maclurcan had broadcast on the previous Sunday evening. Reproduced in the accompanying panel, you can test your wits against those of your grandparents — but don't ask me for a verdict. Typing it was problem enough, without trying to resolve it!

In the second article, we'll look at Charles Maclurcan's research into long distance communication, using high frequencies and low transmitter power.

(To be continued) ❖

SHORTWAVE LISTENING

with Arthur Cushen, MBE



Broadcasting in Vanuatu started by Armed Forces Radio

As the Japanese were defeated in the South Pacific and the Allied Forces moved in, Armed Forces Radio Stations sprung up in various islands. This occurred in the former New Hebrides, Solomons and New Guinea.

This was the first time that radio was brought to these populations. Although it was a temporary Armed Forces Radio Service broacasting English programming and popular music for the Forces, its introduction enabled the local population to realise the potential of radio broadcasting. In later years, most South Pacific Islands commenced a broadcasting service on mediumwave, often with a relay on shortwave.

Typical of this introduction to broadcasting was the New Hebrides, now Vanuatu. On the 25th March 1945, our first reception of the New Hebrides was of the Armed Forces Station operated on 1045kHz, with the call WVUR. The verification letter stated that due to wartime restrictions it was impossible to give specific technical information concerning the station, which was on Espirito Santo.

New Hebrides own radio was heard in the late 1960s and in 1971 the station received a gift from the Australian Government of a shortwave transmitter of 2kW, which operated YJB4 on 3960kHz and YJB7 on 7260kHz. A mediumwave transmitter was donated by New Caledonia in late 1971, with the power of 1kW. It was first heard on 1422 and later on 1125kHz.

In 1976 a breakaway group on Espirito Santo formed a station known as Radio Vemarana. Its broadcasts were heavily jammed by the British from Vila, and later silenced, with its operator Jimmy Molly Stevens being jailed in Port Vila, until 1991.

Before independence, New Hebrides was jointly controlled by France and Britain. After becoming the independent Vanuatu, its broadcasts became known as Radio Vila, which operates on 3945 and 7260kHz, according to a verification dated March 1980. Today, Vanuatu is well received on 3945kHz with English news at 0900.

Hawaii on shortwave

It is 40 years since the last shortwave transmissions were heard from Hawaii. At that time the Voice of America operated a service into Asia which commenced in 1945, towards the end of the war in the Pacific. The Voice of America established two 100kW transmitters near Honolulu, which had the calls KRHO-1 and KRHO-2. Later, the latter was changed to KRHK.

The first broadcast we received was from KRHO on January 4, 1945 on 6120kHz, while the last broadcasting logged was on February 13, 1954, when operating on 9540kHz. The station was then 'mothballed', as by that time the Voice of America had extended its services into more favourable operating areas in the Pacific, including Okinawa and the Philippines.

Shortwave listeners can again listen to a broadcast from Hawaii with the opening of KWHR, which is using a 100kW transmitter and two antennas. Broadcasts will be between six to 18MHz. The initial schedule shows 7425kHz from 1600 - 1800 and 17,555kHz from 0000 - 0200, with the broadcasts being beamed to Asia. The transmitter and aerials are located in a very remote location on the big island of Hawaii.

The programme service will be a relay from the parent station WHRI, South Bend, Indiana and will come from its two transmitters via satellite. The location of KWHR is close to an active volcano, which is causing some filtering problems in the air conditioning plant. However special precautions have been taken to overcome these problems.

KWHR is a relay transmitter only, without any facilities for verifications of reports, so it is suggested that readers write direct to WHRI, PO Box 12, South Bend, Indiana 46624, USA, with their reception of this new signal from Hawaii. ❖

AROUND THE WORLD

ABU DHABI: The latest British schedule shows three new frequencies for the English broadcasts from 2200 - 2400. Programmes are now heard on 9605, 9770 and 11,885kHz. The transmission from 2230 is a relay of Capital Radio FM in Abu Dhabi, which consists of popular music. The schedule shows that this is its only English transmission, and it is beamed to Europe and North America.

BHUTAN: Radio Bhutan at Thimphu has made a frequency change to 5030kHz from the former 5020 outlet. English is broadcast from 1415 - 1500 with news at 1430. The frequency change has resulted in a clearer signal, though some teleprinter interference is observed at times.

BULGARIA: Radio Bulgaria, Sofia broadcasts in English: 0100 - 0200 on 7455 and 9700kHz; 0500 - 0630 on 9700 and 11,720kHz; 1130 - 1300 on 11,645 and 13,645kHz; 1330 - 1500 on 11,630kHz; 1515 - 1645 on 12,085kHz; 1830 - 2000 on 7455 and 9700kHz; 2100 - 2200 on 6085 and 9700kHz; and 2245 - 0015 on 7455 and 9700kHz. Two late frequency changes have been made with 7455 replacing 7355kHz and 12,085 replacing 13,670kHz.

CZECH: The Czech Republic, following its split with Slovakia, found that its main transmitting site was in Slovakia. To correct this problem, it plans to install a 250kW transmitter within the Czech Republic at Rimavska Sobota. Slovakia, however, uses its own transmitting facilities, and in the past, some of these have been loaned to Radio Prague.

LIBERIA: The war in Liberia and the fighting in the capital Monrovia put the local radio stations off the air, but they are gradually returning. ELWA ceased broadcasting in July 1990 during the height of the Civil War. The station is now back on the air with a tentative schedule, and has been heard on 4760kHz between 1630 - 2200. Because of the political situation in Liberia, the station is not carrying news bulletins at the moment. Its mailing address is: ELWA, PO Box 10-0192, 1000 Monrovia 10, Liberia.

MYANMAR: Formerly Burma, its English transmission is noted from 1430 - 1515 on 5990kHz. Though the frequency is clear, it does suffer some sideband interference from stations on either side. Burma is one of the few countries which has a very isolationist policy, so communication with the station is generally rather difficult. It is located in Rangoon, which has been renamed Yangon.

NEW ZEALAND: Radio New Zealand International, Wellington has made two frequency changes due to interference to its channels in the South Pacific. A new schedule is effective up to March 19: 1650 - 1850 on 9655kHz; 1850 - 2139 on 11,735kHz; 2140 - 0658 on 15,115kHz; and 0658 - 1206 on 9700kHz. The frequency of 9550kHz has been replaced by 9655, and 15,120 by 15,115. All night broadcasts are from 1206 - 1650 on 9655kHz.

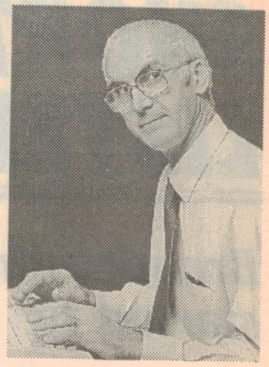
THAILAND: According to Denise Thomson, Chief Assistant to the Chief Engineer, detailed engineering surveys have started in Thailand on the site which has been earmarked for the BBC's next major relay station. The Foreign Office has given its full backing to the building of the transmitting station which is the latest stage in the World Service audibility programme started in the 1980s.

USA: Radio Miami International, using the call WRMI and assigned 9955kHz with 50kW, should be in operation this month. The 50kW transmitter actually came from the Dominican Republic and was used by Radio Clarin. Since being moved to its new site at Miami, it has been completely overhauled, and a transmitter building, studios and aerial systems have been built. The address of Radio Miami International is PO Box 526852, Miami, Florida 33152 USA. ❖

This item is contributed by Arthur Cushen, 212 Earn Street, Invercargill New Zealand who would be pleased to supply additional information on medium and shortwave listening. All times are quoted in UTC (GMT) which is 11 hours behind Australian Eastern Daylight Time and 13 hours behind NZ Daylight Time.

FORUM

Conducted by Jim Rowe



The response to Tom Moffat's column on nasty aspects of ham radio...

Not surprisingly, there's been a fair amount of reader response to Tom Moffat's column in the November issue, drawing attention to some of the nastier aspects of amateur radio. What is perhaps a little surprising, though, is that despite the way many hams regard their activities as something of a 'sacred cow' — beyond criticism virtually no-one has sought to refute Tom's criticisms, or claim they were unjust. Quite the contrary, in fact.

Radio amateurs have been very sensitive to criticism in recent years, and have often reacted rather angrily to any suggestions that all is not entirely well in some aspect of their hobby. When the criticism has come from 'outsiders' it has tended to be dismissed as ill-informed, while criticism from within their own ranks has often drawn claims of 'treachery' and calls for the critic to be ostracised or even banished. I've come in for a certain amount of disapproval myself, you may recall, for having had the temerity at times to offer what I believed were constructive criticisms.

So when Tom Moffat, after a few unhappy experiences on the bands, asked if I had any objection to him criticising some of the less savoury aspects of current ham radio in his November column, we both knew there'd be a strong likelihood that we'd get a strong reaction — and probably a negative one. But I decided to let him 'have a go' anyway, for a couple of reasons:

1. Having been in the editorial chair for a few years now, I know that if people react to what appears in the magazine, it shows they're reading it, at least. And if a lot of people react, a lot of people must be reading it!
2. It probably sounds a bit pompous and self-important, but I still believe an important function of the media in a free and healthy society is to air criticisms of our activities and institutions, and thereby assist in everyone lifting their collective game. And I can't see why amateur radio should be exempt from this process.

Anyway, we published Tom's column — including an undertaking that I would provide an opportunity for readers to comment on the points he made, in Forum. And as expected there *have* been a reasonable number of letters and faxes, so this month we're turning over the column to this first batch of replies. I think you'll find them quite interesting, even though no-one seems to have any serious argument with what Tom said.

The first letter came from fellow amateur Peter Parker, VK6BWI, who hails from Bentley in Western Australia. Here's what Mr Parker had to say:

Congratulations to Tom Moffat for raising the issue of amateur radio again in the pages of your august journal.

Although my first contacts were made on 80m CW with a homebrew valve transmitter (nearly seven years ago), most recently licensed amateurs will probably make their first contacts on two metres FM, or 80m SSB. Having received their callsign from the SMA and set themselves up with a transceiver and antenna, they naturally want to see if they can make a few contacts.

Thumbing through an old callbook they were once given, they notice that the two-metre calling frequency is 146.500MHz. After several hesitant CQ calls, they find that there is no response. (You and I know that most simplex activity consists of little cliques talking inanities on obscure frequencies, often outside the novice segment.)

They find the listing in the callbook for repeaters, and dial up the one nearest to them. Press the PTT... silence. They've forgotten to set the repeater offset switch correctly, so it's back to the manual for their black box. Some time later they try again...

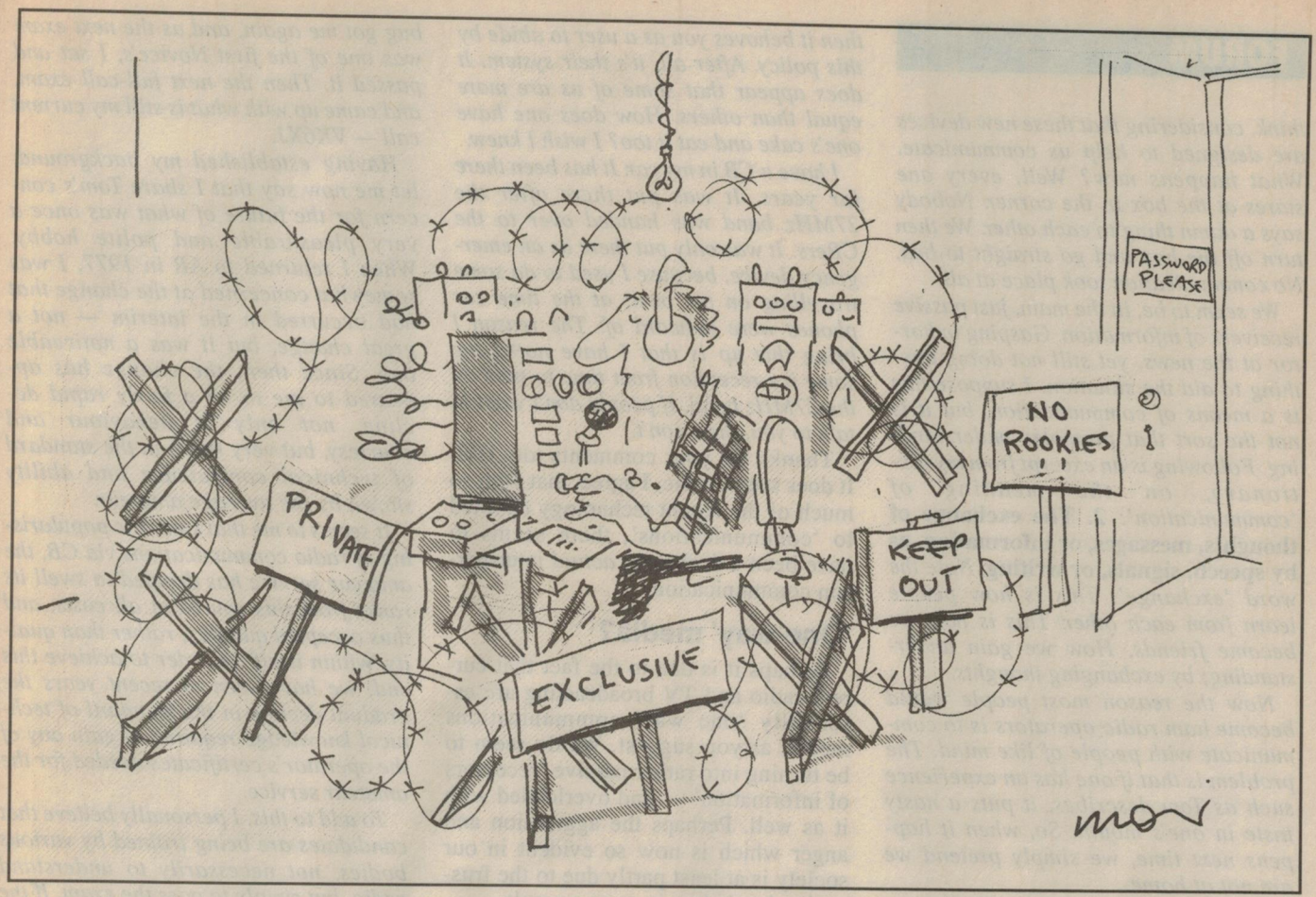
This time a pip is heard coming back from the repeater. Full of trepidation, with shaking fingers pressing on the PTT, another hesitant CQ is broadcast. After a long silence, the repeater tail cuts out. A moment later the repeater springs to life again, as a ham calls his mate in the next suburb. Silence. Another calls a friend, but again no response. Both however heard the calls of our novice, but no reply was forthcoming; his call was ignored.

Meanwhile, at the local club meeting, members were saying how good it would be to have some form of selective calling system fitted to their black boxes, so they only hear calls intended for them and not 'extraneous chatter' (including the call from our novice) through the repeater.

There is a tacit assumption that using a repeater to call CQ is not the done thing, amongst 'real' hams. Indeed, I have seen it written down that it is not good operating practice to call CQ on a repeater, although no reason is ever even. Rather, one should announce one's callsign and the fact that you are listening. Presumably then, you give permission for one of your mates to call you.

80m SSB is similar; most QSOs are pre-arranged skeds — when was the last time you heard someone call CQ on 80m SSB, though this ancient practice is still alive and well in the CW portion of the band. The reason for this is that new hams are eager to see how far their radios can transmit, and will try to make lots of contacts. After a few months, they know the capability of their rigs and, like the rest of us, will settle down and only talk to a small circle of people — or go off the air entirely. Compare the contents of the latest call book with on-air activity, for ample proof of this.

Perhaps when more were building their own equipment (a task which has never been easier, despite grumbles of component availability), more people were interested in seeking new contacts and signal reports; in effect, every time you build a new transmitter you become



like a novice again. With reliable equipment and repeaters, there is no need to make contacts to see how far you can go, because you already know; so why reinvent the wheel?

While I have heard on-air situations where a little more tact might have been called for, in nearly 10 years of listening I have never heard blatant use of unseemly language or personal abuse over the air. While some of the most helpful people I have known are radio amateurs, the perception which is apparently widespread, and in some cases justified, amongst potential radio amateurs that we are a silent lot, who keep exclusive company only, must be challenged.

And one more stirring. Given the almost hysterical reaction by some radio amateurs when the recent Optus satellite link was kindly made available for our use during JOTA ("Look! I can talk across Australia with my (black box) handheld radio" — with a little help from the local repeater which someone else built, and Optus), it makes one feel that it would be economically more sensible for the authorities to auction off most of our bands, and give us free use of a couple of NBFM satellite channels linking the capital cities, instead!

Hmmm, thanks for those comments, Peter. Your description of the way novices, newcomers and even 'occasional' callers on the bands can be treated with stony silence is a good one, and gave me a strong feeling of *deja vu*. Ironic, isn't it, when one of the long-standing myths of amateur radio is that hams are always eager to help newcomers!

One of the myths?

I suspect that particular myth is nowadays in much the same category as the one about hams as being engaged in experimentation, and seeking to extend the frontiers of communications technology. It's true that there *are* hams who keep these myths alive, but they now seem to be pretty thin both on the ground and on the air...

Perhaps, as you suggest, if more people were still engaged in building their own gear rather than buying 'black boxes', things might be a little different. I'm sure you're right that every time someone builds a new transmitter/transceiver, they become like a novice again. I know that's certainly happened to me.

I'm not going to comment on your suggestion about auctioning off the bands and swinging hams over to a couple of satellite channels, though — I suspect it has the potential to generate much more wrath and fury than Tom Moffat's entire column!

Moving on, another letter responding to Tom's comments came from Mr Bill Hughes, of Gladstone in Queensland. Bill's letter was fairly long, and touched on other subjects as well, so I've had to prune it a little. But here's the main gist of what he had to say:

The November edition of Moffat's Madhouse raises some pertinent issues. In my humble opinion it is a sign of the times.

Aah! I remember the time when there was no TV. People were more respectful of each other, and more polite. Not that TV is to blame. No, WE are to blame.

In those days people would communicate. They would converse with others. Complete strangers would bid each other good day in the streets, and smile at each other. I remember my parents playing cards at night, and talking as they played. People would go out to dances and the movie theatre. At the dances admittedly there may have been cliques, but people did communicate. At the movies, during half time, people always talked to each other.

Now we have all these new technological devices to help us communicate, but do we? Well, not as well as one might

think, considering that these new devices are designed to help us communicate. What happens now? Well, every one stares at the box in the corner. Nobody says a damn thing to each other. We then turn off the box and go straight to bed. No communication took place at all.

We seem to be, in the main, just passive receivers of information. Gasping in horror at the news, yet still not doing anything to aid the situation. I suppose this is a means of communication, but it is not the sort that promotes understanding. Following is an excerpt from my dictionary, on the meaning of 'communication': **2. The exchange of thoughts, messages, or information, as by speech, signals, or writing.** *Note the word 'exchange'. This is how people learn from each other. This is how we become friends. How we gain understanding; by exchanging thoughts.*

Now the reason most people would become ham radio operators is to communicate with people of like mind. The problem is that if one has an experience such as Tom describes, it puts a nasty taste in one's mouth. So, when it happens next time, we simply pretend we are not at home.

The hard part for someone in this case is to bite the bullet: Dare to tune to the band where the novices reside.

No, I am not a ham operator. Just a friend, trying to make some sense of all this. Addressing the reader now, I say "I have reached out and tried to be of help. Can you?" If you are someone who has copped this abuse, I wouldn't blame you if you didn't. You would have to be pretty thick skinned.

As far as advertising on packet radio is concerned, it is in essence a BBS with a radio interface. BBS's around the world have advertising. So you say "But it's supposed to be a non commercial, non-profit venture"; so are many of the ordinary BBS's. People will use it to advertise.

People use the old, genuine bulletin boards in shopping centres and other places to advertise. That's what BBS's are for, aren't they? So it seems that Baycom are banging their own drum. However, if they intend to stay in business, then they would be well advised to concentrate on running their business, instead of indulging in vindictiveness. All their rambling won't make Pocket Packet go away.

One thing though, if the people who provide the service that you ring have a policy of no commercial advertising, then it behoves you as a user to abide by this policy. After all, it's their system. It does appear that some of us are more equal than others. How does one have one's cake and eat it too? I wish I knew.

I have a CB in my car. It has been there for years. It was put there after the 27MHz band was handed over to the CBers. It was only put there as an emergency device, because I used to do some travelling on my own; at the time car phones were unheard of. The reason I bring this up is that I have noted the same icy reception from time to time on the 27MHz band. If people don't want to talk to you, they won't.

Thanks for your comments too, Bill. It does seem ironic, I agree, that with so much of the recent technology devoted to 'communications', there seems to have been a decline in *actual* inter-person communication.

'One-way' media?

Perhaps it is due to the fact that current radio and TV broadcasting are essentially 'one way' communications media, as you suggest. We do seem to be turning into rather passive 'receptors of information' — and overloaded with it as well. Perhaps the aggression and anger which is now so evident in our society is at least partly due to the frustration bottled up in us as a result...

Anyway, moving on again, another letter came from a second amateur in Western Australia: Mr John Tuppen, VK6XJ, of Sawyers Valley. Here's what John had to say:

I read Tom's November column with great interest just now, and felt sufficiently moved to pen this, my first ever 'letter to the editor'.

I discovered amateur radio as a young lad back in the 1950's, by the simple expedient of gradually removing turns from the home-brew Reinartz coil that I used with the regenerative receiver (type 30 triode!) I was currently playing around with. With the passage of time, my short-wave listening progressed through several home-made receivers, the inevitable disposals 3BZ, AR8 and so forth, as I went on to various technical radio pursuits. These included being a flight radio operator, working in broadcast stations etc., and eventually to nowadays running my own business selling and servicing two-way radio equipment. (Not associated with AR!)

Along the way many other things occurred, but radio was never far away in my mind. I went for the AOCP in 1962, made an 'orrible mess of the Morse, and didn't get back to it all until I found myself in an amateur's shack in 1977. The bug got me again, and as the next exam was one of the first Novice's, I sat and passed it. Then the next full-call exam, and came up with what is still my current call — VK6XJ.

Having established my background, let me now say that I share Tom's concern for the future of what was once a very pleasurable and polite hobby. When I returned to AR in 1977, I was somewhat concerned at the change that had occurred in the interim — not a great change, but it was a noticeable one. Since then, the change has appeared to me to be a fairly rapid decline, not only in behaviour and courtesy, but very much in the standard of technical competence and ability shown by the average amateur.

It seems to me that since the popularising of radio communications via CB, the amateur service has decided to swell its ranks from this source at all costs, and thus accepted quantity, rather than quality, within itself. In order to achieve this end, we have seen in recent years the gradual decline in the standard of technical knowledge required to gain any of the operator's certificates needed for the amateur service.

To add to this, I personally believe that candidates are being trained by various bodies, not necessarily to understand radio, but simply to pass the exam. If the trend continues much further, we may as well throw the bands open to all comers, as has been done on CB, and that WILL be the end.

Already, not only the general public, but the communications industry as well, finds it very difficult to differentiate between AR and CB. This unfortunate fact contrasts so much with the opinions of 30 years ago, when the industry regarded the holding of an amateur licence as a plus when considering one's attributes. Nowadays, the reverse is a distinct possibility.

I don't want to enter into the discussion relating to packet radio, or the commercial aspects of Tom's argument, as I am not familiar with them, but I do know that if the situation continues, it will become harder and harder to attract worthwhile newcomers to the hobby, as its reputation is deteriorating rapidly.

We hear very low standards of discussion on the bands, rudeness in the extreme, foul language and dirty signals. Is it any wonder then that 'cliques' have arisen, and one is rather reluctant to join in contacts or reply to calls?

I would like to make the following suggestion. A further class of licence could be created above the present full call, maybe something like the American

extra-class, with a return to the written exam, and a lean towards the technical understanding of radio com- munication in the real world. I would like to see it have a practical part, where a candidate would have to demonstrate an ability to build and fault-find simple radio equipment (not full-blown SSB transceivers!). By this means we may return some portion of what was once a wonderful hobby and learning experience to a respectable level.

I think our general standards for the other classes of licence must also be raised to some extent. We should be prepared to sacrifice some quantity for quality. If we don't do something like this, AR is doomed, as eventually the authorities will decide that the spectrum resources we are using should not be wasted on such trivial activities. As our standards continue to fall, we may very soon see that our cherished privilege of using non type-approved equipment may be lost, as the average operator will no longer have the technical competence to assume responsibility for the operation of such equipment.

I know this view is an unpopular one, and my comments and suggestions will be torn to shreds. I don't care. AR is worth saving, and someone had to have the guts to say these things.

With some minor qualifications, 'Good on yer, Tom'.

Thank you also for those carefully considered comments, John. It's clear that you have a strong involvement in amateur radio, and have written out of a concern for its survival.

Perhaps you're right that the amateur radio 'service' needs to differentiate itself more from CB, and that this could be achieved by 'raising the bar' and making entry harder, rather than easier. However I suspect this suggestion won't be too popular, as you predict yourself...

Worse in NSW!

Our final letter on this topic (for the present at least) comes from much closer to home. It comes from Mr Robert Whitcombe, of Redfern in Sydney, and far from believing Tom Moffat was too harsh in his criticisms, Robert seems to suggest he wasn't harsh enough! His letter was also very long, but I've left most of it intact, because he makes some very interesting comments:

I was prompted by the November Moffat's Madhouse to write and air my views on a couple of the topics he touched upon. I hasten to add that I am not a 'ham'; nor am I a 'CBer', and don't even consider myself to be a 'SWLer'. But I hope that what I express will be taken as observations of an long-interested bystander.

Tom's reaction to his on-air experiences makes me wish that he could have heard before, during and after, the Sunday WIA morning broadcasts on two metres from Dural over the last 10 weeks, to realise how fortunate he was. In truth, even worse behaviour than that which Tom experienced has been rampant there for a considerable period of time.

By my recollection, hams have been pressing to have more control over their affairs and bands for at least 25 years, but now, in these days of 'self-regulation' — where is it?

Why hasn't the local chapter of the WIA formed a bloodhound committee, headed by a radio inspector in co-operation with the police, to go on 'seek and destroy' missions and deal decisively with such transgressors of the regs — and also discourage any future would-be offenders?

By inaction, painful misbehavior as can be heard every Sunday morning is only encouraged. And unless the hams aggressively demonstrate their 'asked-for' responsibilities in the regulation of THEIR bands, it could be perceived that they are unable to cope with such a responsibility — and control will revert back to the government.

Tom referred to the seizure of the 12-metre band and the apparent resentment it caused. Considering that, and other on-air comments that I have heard on the bands over the years, it seems that everyone has forgotten a vital point on the whole issue of the electro-magnetic spectrum: that is, that it is an exploitable natural resource. Because of that, no government has the right to exclude citizens from access and the CB band had to go somewhere.

To follow this reasoning further, a transmitter is a controlled 'pollution device', and we the people have granted and expect the government to regulate these devices in the appropriate fashion in order for this resource to be enjoyed by all without interference — which quite obviously means licensing, band-plans, transmitter specs, and emission levels from computers, burglar alarms and so on.

This also means policing against the kinds of anti-social behaviour referred to above. Considering that the government is extracting a sizable amount of lucre from its supposed 'guardianship' of this natural resource, then it is failing in its duty (which could be looked upon as a form of re-investment) by allowing such behaviour to continue.

Continued on page 91

Construction Project:

LOW COST EGO TESTER

As mentioned last month, we received this second design for an EGO (exhaust gas oxygen) sensor tester within days of receiving our columnist Al Younger's own design as described in the January issue. Because of the high interest in automotive electronics and 'do it yourself' car repairs at present, we decided to present this one too — so that you now have the choice of building either, or both!

by PETER KILLIN

As a motor mechanic involved in the training of other motor mechanics, I am constantly faced with ever-increasing automotive developments, particularly in the area of electronic controls. The automotive repair industry is currently in the process of merging two seemingly unrelated technologies: mechanics with electronics. (Or is it electronics with mechanics?)

For we motor mechanics, this is real pioneering stuff — Indianapolis Jones and the temple of zoom! We are used to diagnosing faults in automotive devices by the type and intensity of the noise they make. These faults are usually fixed by taking the lid off, viewing the various internal components, selecting the items that require repair and swapping them. Relatively easy...

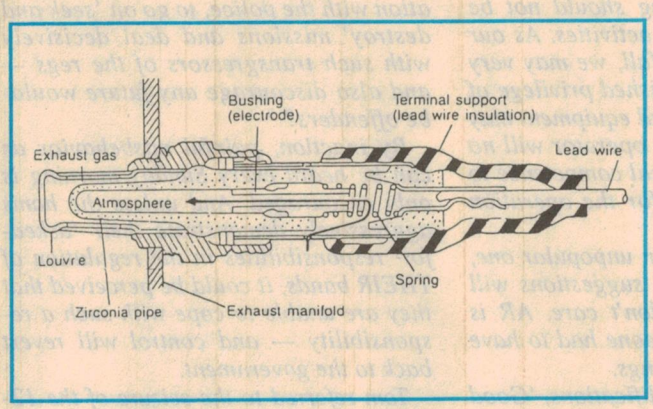
Not so any longer, though. By genuine experience we have found that lifting the lid off electronic devices often causes the 'smoke' to leak out, and they won't ever work again!

Many automotive trainers and technical scribes of the day are currently very busy expanding their understanding of the very black art of electronics. The reason is obvious.

This is necessary to ensure motor mechanics are able to comprehend and therefore capably service, diagnose and repair the modern motor vehicle's many and varied electronic systems. Just a few of the more conspicuous ones are:

- Electronic fuel injection (EFI)
- Electronically controlled transmissions
- Cruise control
- Anti-lock brakes
- Air bags
- Four wheel steering
- Traction control; and
- Security and immobilisation systems.

Over the past few years, I too have joined these ranks, taking every opportunity to increase my understanding of the 'non-understandable' (I refer of course to electronics, not females!).



A diagram showing the internal construction of a typical exhaust gas oxygen or 'EGO' sensor. The active element is a 'thimble' of zirconia, with its outer surface exposed to the exhaust gases and its inner surface to the outside air.

One of the means I have used to this end, is to read electronics magazines — such as this one. (Yes, there are others — but I don't subscribe, I just read *them* at the local library!)

Whilst a large proportion of their content is either way over my mechanical head or of little interest, what I have been able to do is glean bits and pieces of interesting information and experiences, which has no doubt added a practical element to this ever increasing(?) knowledge.

What I plan to do now, is present a simple yet interesting electronic project (well at least I think it is), which I have used with my mechanically-minded trainees to increase their appreciation of electronics.

Then we will see how this project is applied as a test instrument to a modern electronic engine management system. The original source of the circuit is uncertain, but it is well proven and is presented here for the benefit of those who may find it interesting and/or useful.

The device in question is an EGO tester. Does this mean you hook it up to a battery and to your left ear to determine the state of your own ego? No, definitely not! For the duration of this article, the term EGO refers to an **Exhaust Gas Oxygen** sensor.

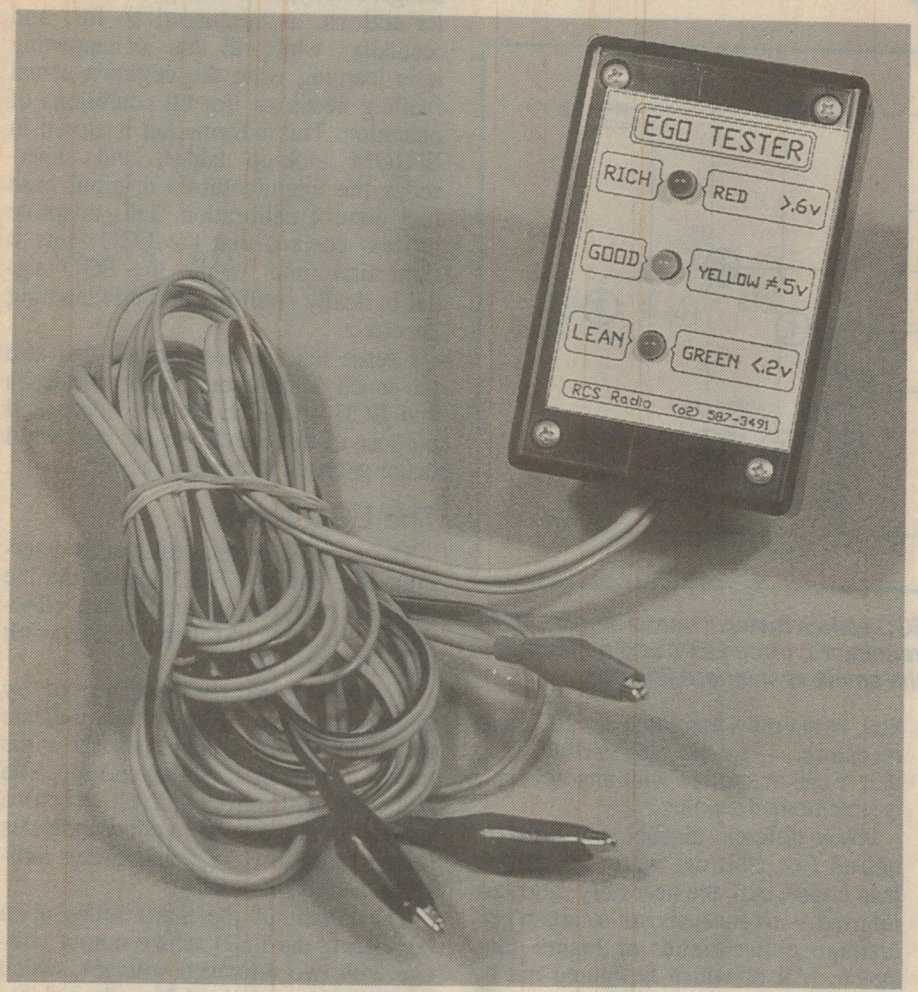
Before we begin with the tester, I guess we need to discover (perhaps to some: review) a little about the operation of the EGO sensor and its function within an engine management system.

Whilst the subject here is not engine management systems as a whole (since this would take several volumes to begin scratching the surface), there are a few points we need to remember about every electronic system when applied to a mechanical contraption such as the internal combustion engine.

Such a system will have these basic components:

1. **Sensors**, which provide information on operating conditions or input quantities;
2. An **electronic control unit** (ECU), which processes this information and in turn controls:
3. Various output **actuators**, through which it runs the engine.

The EGO is just one of many input sensors, which provide the ECU with necessary information regarding the engine and its current operating conditions.



The EGO sensor

The EGO sensor is usually situated in the exhaust manifold, as close as possible to the engine. Some EGOs actually have a heater fitted to them (for 'cold-blooded' engines), ensuring rapid sensor operation after start-up. These types are referred to as 'HEGOs' (here he goes again!), which of course stands for Heated Exhaust Gas Oxygen sensors. All this is necessary because an EGO won't begin to produce valid signals until it has reached a temperature of around 300°C, with normal operating temperatures being in the region of 600 - 800°C.

The EGO sensor's function, whether it's heated or not, is to provide the ECU with information (feedback) regarding events that have previously taken place deep within the engine's cylinders. Basically the ECU initiates certain functions such as injecting fuel and triggering a spark, and then checks to see if it all went according to plan — via the EGO sensor.

Just as the good old 'doc' can look at refuse from our body to determine if all is well within, the ECU can tell from the oxygen content of the exhaust gases whether the engine is operating within the narrow window of optimum air/fuel ratio.

This window (termed the *stoichiometric point* or *lambda*), is necessary to provide minimal exhaust emissions and maximum fuel economy. I am sure you won't have a problem with either of those requirements!

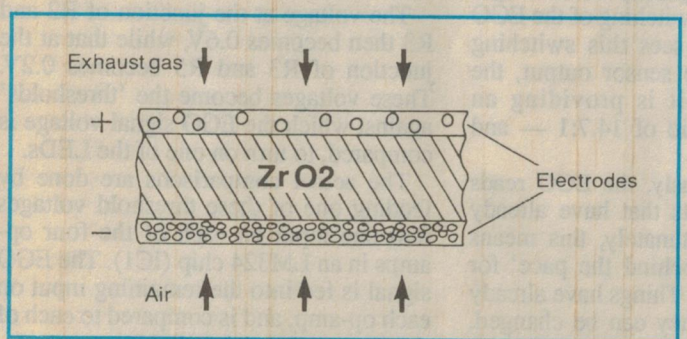
Inside the sensor

The EGO sensor is simply a voltage generator, which usually puts out a signal that varies in a range of from 0 - 1V. It consists of a ceramic thimble of zirconium dioxide (ZrO_2, also known as 'zirconia'), which is coated on both sides with a thin layer of micro-porous platinum, forming two electrodes.

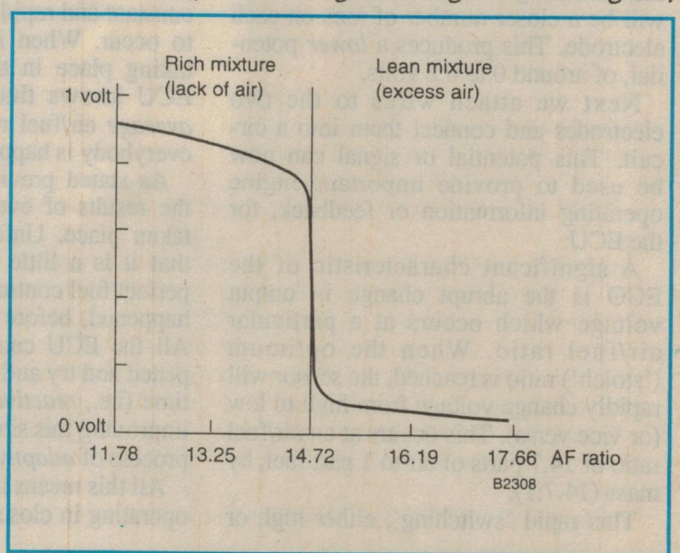
The outer electrode is subjected to the passing exhaust gases, whilst the inner electrode is open to the outside atmosphere, via an external vent in the EGO housing.

Now when zirconium 'di' is heated above 300°C, apparently it attracts to its surface negatively-charged atoms (called ions), from the oxygen in our atmosphere. This is not to be confused with Princess Di, who attracts photographers from everywhere!

These ions gather on the *inner* platinum electrode. In the same way, ions will be 'sucked out' of any oxygen remaining in the engine's exhaust gases,

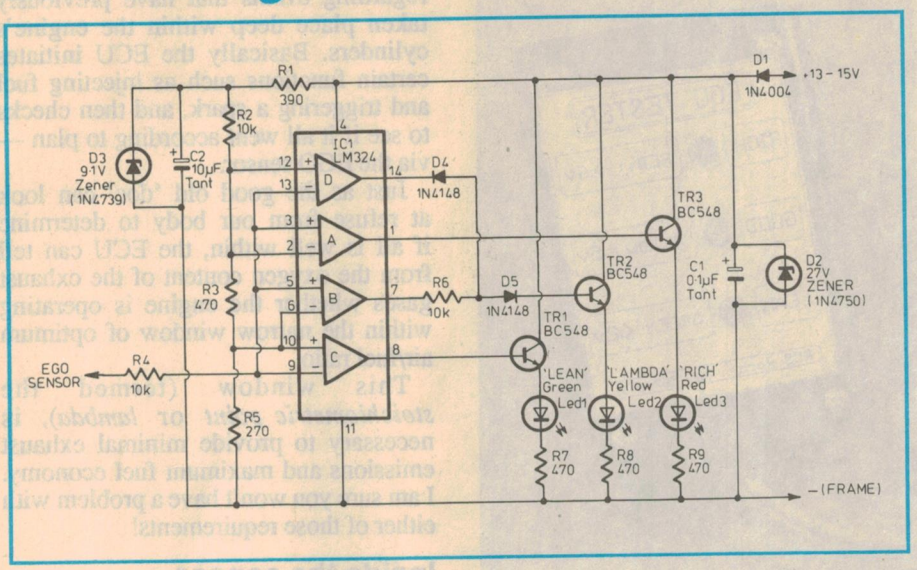


Above: The zirconia material attracts oxygen ions, and because there are fewer of these in the exhaust gases, fewer ions attach to the surface on that side. As a result, a voltage difference is generated between the surfaces.



Right: The sensor output voltage is above 0.7V for rich mixtures and below 0.2V for lean mixtures, 'switching' at the stoichiometric air/fuel ratio of 14.72:1.

Low cost Ego Tester



The schematic for the author's low cost EGO sensor tester. It uses a single LM324 quad op-amp IC, combined with three transistors, three LEDs and a handful of other components. Everything fits into the smallest standard jiffy box.

as they pass by the sensor. These ions will in turn gather on the *outer* electrode.

Now if we have more of these charged ions on one electrode than the other, a potential difference will exist. There is more oxygen in plain air than in exhaust gases, so more of the negatively charged ions will collect on the inner electrode than on the outer one. So a small voltage is generated, between the EGO sensor's output terminal and the frame.

If the engine is operating with a *rich* mixture, the oxygen content of the exhaust gas will be very low, causing far less ions to be gathered on the exhaust electrode than the atmospheric electrode. This situation produces a *high* potential difference, of around 0.8 to 1.0 volt. On the other hand if the air fuel mixture is *lean*, the oxygen content of the exhaust gas will increase and there will be a closer number of ions on each electrode. This produces a *lower* potential, of around 0 to 0.2 volts.

Next we attach wires to the two electrodes and connect them into a circuit. This potential or signal can now be used to provide important engine operating information or feedback, for the ECU.

A significant characteristic of the EGO is the abrupt change in output voltage which occurs at a particular air/fuel ratio. When the optimum ('stoich') ratio is reached, the sensor will rapidly change voltage from high to low (or vice versa). This occurs at an air/fuel ratio of 14.7 parts of air to 1 part fuel, by mass (14.7:1).

This rapid 'switching', either high or low, is the only thing that the ECU can recognise — so the only air/fuel ratio that it can determine with any accuracy is stoichiometric point.

When different air/fuel ratios are required (for starting, warm-up, power, lean cruise, etc), the necessary ratios are inferred — as consisting of a certain percentage either richer or leaner than stoich. (All of which is figured out by the ECU, in far less time than it takes to spell 'stoichiometric').

Closed loop control

Now, what is the ECU going to do with this information? Well, what it attempts to do is maintain the mixture at stoich, by means of 'closed loop' fuel control. It does this by constantly increasing and decreasing the fuel injector pulse width — marginally — causing a constant and rapid switching of the EGO to occur. When it sees this switching taking place in the sensor output, the ECU knows that it is providing an *average* air/fuel ratio of 14.7:1 — and everybody is happy.

As stated previously, the EGO reads the results of events that have already taken place. Unfortunately, this means that it is a little 'behind the pace' for perfect fuel control. Things have already happened, before they can be changed. All the ECU can do is see what happened and try and get it right for the next time (i.e., *reactive* control). A means of improving this situation is by initiating a process of *adaptive strategy*.

All this means is that while the ECU is operating in closed loop, it is doing two things. Firstly, it is seeing the results of its actions, as discussed so far; and secondly, while all this is happening it is learning what the engine's actual fuelling needs are for all conditions of operation. This information is stored in EPROM look-up tables, and supersedes the manufacturers original base fuel control calibration. This adaptive process ensures that the ECU 'gets it right first time', while the EGO signal basically confirms that this learning is correct.

I sense that we are about to get into too much depth about engine strategies and ECU operation for the space and purpose of this article, so for now we'd better get back to the EGO tester...

The EGO tester

The purpose of this tester is to determine that both the EGO sensor and the ECU are carrying out their duties effectively. If not, we can then use it to work out which is at fault.

All this is easily determined by monitoring three LEDs, which indicate the actual sensor voltage and show the rate of switching at any given time. The red LED indicates a rich mixture (greater than 0.6 volts); yellow indicates stoich (around 0.5V); and green indicates lean (0.2V or less).

The circuit of the tester relies upon comparing the EGO sensor output voltage with two reference voltages, which are themselves derived from the vehicle battery voltage using a zener diode shunt regulator and a resistor voltage divider. Vehicle battery voltage (13-14V) is fed to the circuit via protective diode D1, and then used to set up a regulated source of about 9V by feeding it through series resistor R1 to shunt zener diode D3. The resulting 9V is then applied to the top of the divider formed by R2, R3 and R5.

The voltage at the junction of R2 and R3 then becomes 0.6V, while that at the junction of R3 and R5 becomes 0.2V. These voltages become the 'thresholds' against which the EGO signal voltage is compared, to turn on one of the LEDs.

The actual comparisons are done by feeding one of these threshold voltages into one input on each of the four op-amps in an LM324 chip (IC1). The EGO signal is fed into the remaining input on each op-amp, and is compared to each of the above voltage thresholds.

By way of revision, an op-amp is a high gain amplifier, constructed from many transistors and built into an integrated circuit package. It has two inputs (or controls), two power supply connections (may be positive or nega-

tive) and one output (which can either 'source' or 'sink' current, depending on whether it's *high* or *low* in voltage).

An op-amp will amplify the *difference* in voltage between the two inputs and provide an output voltage proportional to this difference.

Due to the extremely high gain of an op-amp, it only takes a very small difference in voltage between the two inputs to swing the output either high or low. Depending on which of the two inputs is the highest voltage, the op-amp effectively varies the polarity of its output. In this application, the four op-amps in IC1 (which share power supply connections) are used as *comparators*, rather than as amplifiers. As a comparator, the op-amp's action can be summarised this way:

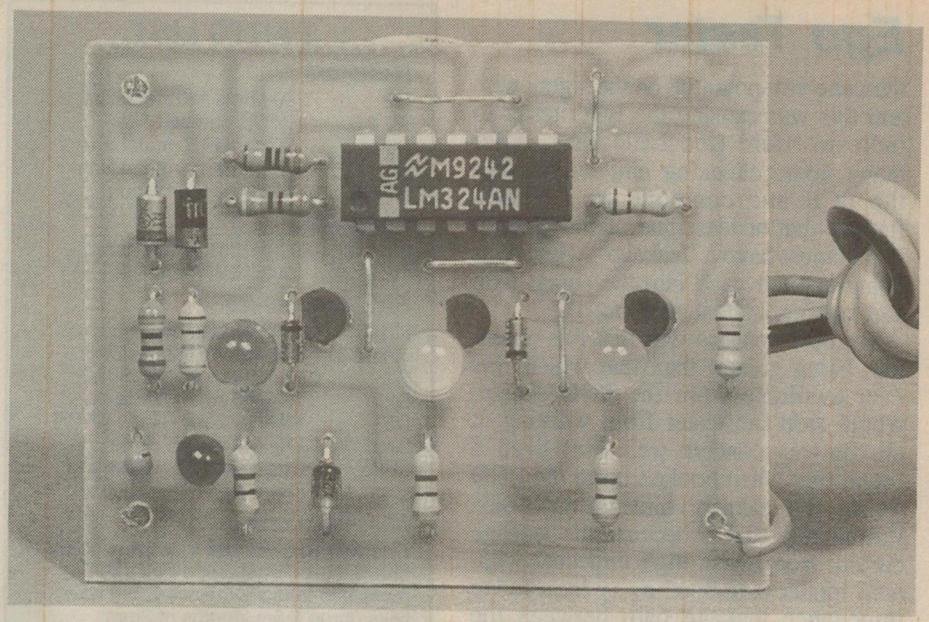
- If the *positive* input is at a higher potential than the negative input, the output will be high (+). The comparator will then 'source' (supply) 13 volts from its output terminal.
- If the *negative* input is at a higher potential than the positive input, then the output will be low (0V). The comparator will 'sink' to ground whatever potential is connected to its output.

Returning to our circuit, when the EGO signal is 0.2 volts or below (i.e., a lean mixture), the output from comparator C will be high (positive input at a higher potential than the negative input). This will switch ON the base of transistor TR1, which feeds current to the green LED (via R7), indicating a lean mixture. None of the other LEDs will be lit at this stage.

When we have a mixture nearer the stoichiometric point, the EGO voltage should exceed 0.2V. The increased voltage on the negative input of comparator C will drive its output low, removing power from the base of TR1 and switching OFF the green LED. At the same time, the higher EGO voltage applied to the positive input of comparator B will cause this op-amp's output to switch high. This powers the base of TR2, switching ON the yellow LED.

As the mixture becomes richer and the EGO signal voltage rises further, it finally exceeds 0.6V. When this happens comparator A will provide a high output, powering the base of TR3 and switching ON the red LED.

At the same time, comparator D with the reversed input connections will switch its output low; this will sink the output from comparator B to ground through R6 and diode D4, switching transistor TR2 and the yellow LED both OFF. This ensures that only one LED is ON at a time.



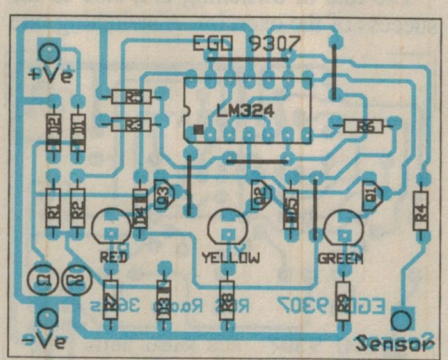
A close up view of the PC board for the EGO sensor tester, showing where everything goes. As you can see, there's very little involved.

As the vehicle's ECU maintains closed loop operation, varying the air/fuel ratio and hence the oxygen level in the exhaust gases up and down, the EGO output voltage will swing up and down with it and this will be shown by a 'cycling' of the LEDs.

Building it

The parts needed to build the EGO tester are shown in the parts list. As you can see from the photos, everything fits on a very small PCB. This measures 56 x 45mm and is coded EGO9307. Boards are available for around $5.00 from RCS Radio, of 651 Forest Road, Bexley NSW 2207; phone (02) 587 3491.

The PCB fits into the smallest standard 'jiffy' box, measuring 83 x 54 x 28mm ('UB5' size), with the three LEDs just protruding from three holes drilled in the lid. The leads which connect to +13V, vehicle frame and the EGO sensor



The overlay diagram for the EGO sensor tester, to guide you in assembling the parts on the PCB.

are brought out through a 6mm hole in one end.

Assembly is pretty straightforward, so I won't spend much time here. Don't forget to install the five links, as shown by the lines on the PCB overlay. Solder the LEDs to the PCB with enough lead length to enable them to just protrude through the holes drilled in the jiffy box lid. The recommended lead length of 2.5m should be sufficient to allow the tester to be propped up on the dashboard whilst the vehicle is being driven.

The main assembly fault I have seen, on those that have been made up to date, is fitting diodes D4 and D5 in the wrong way around. If this occurs, the yellow LED will not light.

If zener diode D2 (used to absorb voltage 'spikes') is installed back to front, the smoke may leak out and you must go direct to jail without passing GO! Not really, but you'll almost certainly have to buy a new zener...

Testing the tester

Once your tester is assembled, a bench test is in order. Connect the power and ground leads to a battery (around 12V) and the red LED will light up. Since there is no voltage applied to the EGO signal wire at this point, one might expect to see the green (lean) LED lit up.

In fact, the first time I assembled a tester, I thought I had done something terribly wrong. I could not see how any voltage could possibly be applied a signal wire that was connected to 'thin air'. A quick check with the Fluke DMM revealed that there was slightly more

than one volt potential on the signal wire and this was causing the EGO tester to indicate 'rich' (red LED ON). After many hours checking and re-checking the PCB and components, I finally figured that at least one of the op-amp inputs must have a 'leakage', which was being applied back into the signal wire and making it 'float' at about 1V.

My next concern was that this potential, being greater than that which was ever available from the EGO sensor, would stop the tester from working at all. But my concern was short lived. I found that when hooked up to the EGO sensor, the leakage voltage drops away. Presumably this is because the leakage current from these high impedance op-amp inputs is drained away by a lower impedance leakage path between the EGO sensor's electrodes, leaving the capacitive 'charge' generated by the ions on the EGO electrodes as the only source of voltage.

I then found that by flicking the sensor wire against the battery ground terminal momentarily, the remaining LEDs operated in turn. A more exact way of testing would be to apply an adjustable DC voltage to the sensor wire, looking for each LED to light up at the appropriate voltage.

Using the tester

Now is the big moment. The time has come to hook your EGO tester up to a vehicle. The best way to attach the testers' signal lead is to carefully back-probe the EGO wiring connector. This is located close to the sensor, usually within six or eight inches. In most situations, this may require a connector seal to be partially removed. If this is the case, do so carefully and ensure it is refitted correctly once testing has finished.

Be careful if you use one of those 'spike' connectors to pierce a wire's insulation and reach the conductor. If you do, you will create a potential source of water entry into the wire, which may end up causing corrosion and further problems in the future. It is best to seal up any such connections with a silicone sealant when testing has finished.

Next, connect the tester power wire up to the battery positive terminal and the negative lead directly to the engine block or cylinder head (not the battery negative terminal as you might expect). This ensures that any poor ground connections between the engine and battery do not affect the accuracy of the testers' readings.

PARTS LIST

Resistors

R1	390 ohms 1% metal film
R2,4,6	10k 5% carbon
R3	470 ohms 1% metal film
R5	270 ohms 1% metal film
R7,8,9	470 ohms 5% carbon

Capacitors

C1	0.1uF 35VW tantalum
C2	10uF 16VW tantalum

Semiconductors

IC1	LM324 quad op-amp
TR1,2,3	BC548A NPN transistor
D1	1N4004 diode (400V/1A)
D2	1N4750 zener diode (27V)
D3	1N4739 zener diode (9.1V)
D4,5	1N4148 silicon diode
LEDs:	One each red, yellow and green (5mm)

Miscellaneous

One Jiffy box, 85 x 54 x 28mm; one PC board, 56 x 45mm, code EGO9307 (available from RCS Radio); five wire links; three 2.5m lengths of 2mm automotive cable (red, black and green) for test leads; three alligator clips (same colours).

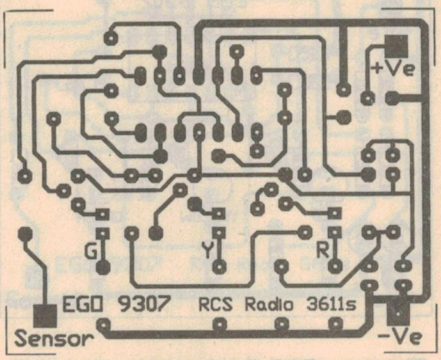
Test procedure

The sensor must be brought up to operating temperature before it will begin to send valid signals. So drive the car for a couple of kilometres and by then, the tester should begin to light up like a Christmas tree.

When you begin driving, if the sensor is cold, the tester will initially light the green LED, indicating a low voltage output from the EGO sensor. Once warmed up a little, it will begin to produce valid voltage signals and should begin by showing a rich mixture (red LED on).

Once the engine itself approaches operating temperature and there are no excessive demands for power placed upon it, closed-loop operation will be initiated by the ECU and the tester LEDs will indicate the 'switching' EGO by constantly flashing from rich to stoich ('lambda'), then to lean and vice versa.

The rate of switching is a clue to the success of the exercise. A switching rate of around once per second with a fairly equal excursion into the rich or lean domain, indicates a healthy EGO sensor and also proves the ECU's judgment of the situation is correct.



And here is the PCB pattern, reproduced actual size for those who wish to etch their own.

Some additional characteristics to keep an eye on are:

- The length of time from cold start before the EGO begins to switch
- The mixture should be rich on acceleration and lean on deceleration
- Some systems run a 'lean cruise' strategy, which will switch and 'clamp lean' (hold the mixture lean) after a pre-determined period, under cruising conditions. This improves fuel economy, so be aware of this one.
- At idle, most systems remain in closed loop. However in order to improve idle quality, some systems 'clamp rich' after a certain period of time (around 5 - 20 seconds).

The only way to know the actual characteristics of a particular vehicle is to monitor the operation of as many vehicles as you can, to get a good feel for what is normal. (Is this the same for TV's too?)

EGO diagnosis

The most obvious faults which occur with EGO sensors are that they do not switch at all, or are very slow or 'lazy' in their switching. If the EGO voltage remains either high or low, we need to determine if the fault is actually in the sensor, or if the ECU is not carrying its share of the work. That is, the EGO output may be fixed because the air/fuel ratio isn't being varied...

The easiest way to prove this out is to deliberately introduce a rich, and then a lean mixture and look for any changes in the signal. In most systems, opening the throttle rapidly for a few moments will provide a rich mixture as the engine speed increases. After a few seconds, the throttle is then released, providing us with a lean mixture. If we get prompt switching of the EGO under these conditions, it indicates that the EGO is working.

The next step is to hold the engine speed up at around 2500rpm and watch the LEDs, as the ECU enters closed loop. If this does not occur and the signal remains *low*, there are three possible areas of concern: We either have a fuel supply problem (such as blocked injectors); an engine mechanical fault, such as an intake air leak; or the ECU is providing an incorrect output as a result of incorrect inputs (or even an internal ECU fault). If the EGO voltage

Continued on page 83

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5¼ DS/HD	$18.95	$17.95

CARDBOARD BOXES

Description	1-9	10+
3½ DS/DD	$17.95	$16.95
3½ DS/HD	$25.95	$24.95
5¼ DS/DD	$12.95	$11.95
5¼ DS/HD	$17.95	$16.95

SIMMS

DESCRIPTION	1-9	25+	100+
1M x 9-60	$99	$95	$89
1M x 9-70	$77	$75	$73.
4M x 9-70	$299	$295	$289
4M x 9-60	$339	$329	$319

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FREE 148 PAGE CATALOGUE
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EPSON PRINTERS BACK TO SCHOOL PRICE CRASH.

LX-400 80 Column, 9 pin Dot Matrix, 180 Cps Draft, 30Cps NLQ, Pull tractor C22054.....**Just $199.00**

LX-100 80 Column, 9 pin DotMatrix 240 CPS Draft, 48 CPS NLQ, 3 Fonts ,50 sheet paper cassette C92094.....**Just $279.00**

LQ-100 80 Column, 24 pin Dot Matrix, 200 CPS Draft, 72 LQ C22070.... **Just $359.00**

LQ-150 with Colour-Kit.
The Epson LQ-150 is a very versitile 24-pin printer. Narrow carriage, colour upgradable, letter quality personal Dot Matrix • 216 cps draft (12cpi) • 79 cps LQ (12cpi) • 80 col • 10 standard fonts
• Standard 50 sheet paper cassette
C92150**Just $499.00**

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VOICE COIL IDE HARD DRIVES

Cap	Av.Access	Tax Inc.	Tax Ex.
131M	16ms	$349	$288
212M	16ms	$379	$310
260M	16ms	$459	$379
345M	12ms	$525	$435
420M	12ms	$699	$577
540M	12ms	$799	$660

BOX HILL STORE NOW OPEN 9 - 3P.M SATURDAY.

SCANNERS

GENIUS SCANNER 4500
Black, white and grey emulation scanner with powerful photo / image editor and multilingual omnifontOCR..$199

BACK TO SCHOOL SPECIALS

3 BUTTON MOUSE
Microsoft Compatible
Just $19.95

101 KEY KEYBOARDS
Just $35.00

BULK DISK PRICES

DESCRIPTION	1-9	10+	50+	100+	500+
5¼ DS/DD	$4.50	$4.30	$4.30	$4.30	$3.95
5¼ DS/HD	$8.50	$7.95	$7.90	$6.90	$6.90
3½ DS/DD	$7.95	$7.50	$7.25	$6.90	$6.90
3½ DS/HD	$10.50	$9.95	$9.75	$8.95	$8.50

All disks come with Write Protects and envelopes and a life time warranty.

COMPUTER SYSTEMS • Four Year Parts & Labour Warranty

386SX 40	386DX 40	386DX 40 Local Bus	486DX 33	486DX2 50	486DX 50	486DX2 66
$1255	$1295	$1395	$1725	$1852	$2020	$2120
Tax Inc $1519	Tax Inc $1565	Tax Inc $1669	Tax Inc $2089	Tax Inc $2240	Tax Inc $2440	Tax Inc $2570

ALL SYSTEMS INCLUDE 212 MEG HARD DISK - 4 MEG RAM - 101 KEYBOARD - SUPER VGA (1024 X 768) (0.28" DOT PITCH) COLOUR MONITOR - 2 SPG PORTS - 1 MEG VGA CARD 1.44 MEG 3½" OR 1.2 5¼" FLOPPY DISK DRIVE - 3 SLOT VESA LOCAL BUS MOTHERBOARD & VESA LOCAL BUS 1M VGA CARDS ARE SUPPLIED IN 486 MACHINES AT NO EXTRA COST (Up to 1280 x 1024 Resolution) •All 486 motherboards are supplied with Chipaway Anti Virus BIOS Lock and Utilities

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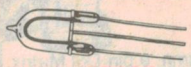

XENON/STROBE TUBES

As used in projects or as replacement.

S14050.....$3.95

CHROME LED BEZELS

9 mm hole, available 3 colours

S14030 Red.....$1.20
S14032 Green.....$1.45
S14034 Yellow....$1.45

GREY FLAT RIBBON CABLE

cat no.		$/Mtr
W12614	14way	$1.90
W12616	16way	$2.20
W12620	20way	$2.50
W12624	24way	$2.90
W12625	25way	$3.20
W12626	26way	$3.60
W12634	34way	$3.90
W12636	36way	$3.90
W12640	40way	$4.90
W12650	50way	$5.90
W12660	60way	$6.90

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10 TURN WIRE WOUND POTENTIOMETERS

Spectrol Model 5341/4" shaft. Equivalent (Bourns 3540S Beckman 7256) Dials to suit 16-1-11, 18-1-11, 21-1-11.

R14050 50R R14100 5K
R14055 100R R14110 10K
R14060 200R R14120 20K
R14070 500R R14080 1K
R14090 2K

1-9	10+
$9.95	$8.95

R14130 50K..... $10.95
R14140 100K..... $10.95

NUMERIC KEYPAD

These are ideal for telephone dial projects or security systems. 4 x 3 encoded keypad. 10 digits with 2 utility keys. Black in colour

S13062.....$7.95

GENERAL PURPOSE TRANSISTORS

PN100: a NPN general purpose medium power amp and switch with continuous collector current up to 500mA. PN200: a PNP general purpose amp at collector currents to 1 AMP. Both are TO-82 plastic package.

PN100 REPLACES:

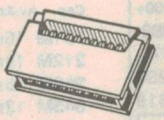
PN2221, PN2222, PN2222A, PN3585, PN3568, PN3569, PN3643, PN5133, 2N2219A, 2N2222A, 2N3414, 2N3415, 2N3416, 2N3417, 2N3700, 2N3704, 2N3904, 2N4123, 2N4124, 2N4401, 2N5088, 2N5210.

PN200 REPLACES:

PN2907, PN2907A, PN3638, PN3638A, PN3640, PN3644, PN4121, PN4143, PN4248, PN4249, PN4250, PN4355, PN4916, PN4917, PN5910, 2N2905A, 2N3467, 2N3702, 2N3906, 2N4125, 2N4126, 2N4291, 2N4402, 2N4403, 2N5086, 2N5087, 2N5447.

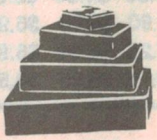
PN100.....T90001
PN200.....T90002

1-9	10+	100+
$0.20	$0.18	$0.15



CARD EDGE CONNECTORS

.1" SPACING	1-9	10+
P12060	10pin $3.95	$3.50
P12062	20pin $4.25	$3.75
P12064	26pin $4.50	$3.95
P12066	34pin $4.95	$3.95
P12068	40pin $5.95	$4.95
P12070	50pin $6.95	$5.95



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Comes with 4 screws

Black in colour.

	1-9	10+
H10120 83 x 54 x 28mm	$1.95	$1.70
H10126 130 x 68 x 41mm	$2.50	$1.95
H10122 150 x 90 x 50mm	$3.95	$3.50
H10124 195 x 113 x 60mm	$4.95	$4.25

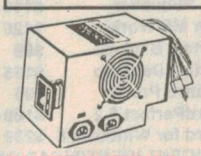
FERRIC CHLORIDE

25% more from RIE at the same price as our opposition

H10810 250gm..$4.95
H10812 500gm..$7.95
H10814 1Kg.....$11.95

DIODES - BUY IN BULK & SAVE!

Cat No.		10+	100+	1000+	10K
Z10135	IN4148	$0.05	$0.04	$0.03	$0.02
Z10105	IN4002	$0.06	$0.05	$0.04	$0.03
Z10107	IN4004	$0.08	$0.06	$0.05	$0.04
Z10110	IN4007	$0.10	$0.07	$0.06	$0.05
Z10115	IN5404	$0.18	$0.14	$0.13	$0.11
Z10119	IN5408	$0.20	$0.16	$0.15	$0.14



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XT P.S. 150W.....$89.00
FULL TOWER
220W P.S.....$99.00
MINI TOWER
200W P.S.....$79.00
BABY AT
200W P.S.....$79.00
SLIMLINE BABY AT
200W P.S.....$79.00

COMPUTER CABLES

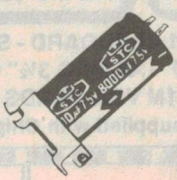
• Six conductor shielded computer interface cable.

	1-9M	10M+	100M+
W12670 • CIC6 6 con.	$1.30M	$1.10M	$1.00M
W12672 • CIC9 9 con.	$1.60M	$1.50M	$1.20M
W12674 • CIC12 12 con.	$2.50M	$2.20M	$1.90M
W12676 • CIC16 16 con.	$3.50M	$3.20M	$2.50M
W12678 • CIC25 25 con.	$3.90M	$3.40M	$3.00M

NICADS

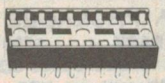
Save a fortune on expensive throw away batteries with these quality Nicads and Rechargers!

Size	1-9	10+	100+
AA 450mAH	$2.95	$2.75	$2.50
C 1 2 A H	$9.95	$9.50	$8.95
D 1 2 A H	$6.95	$5.95	$4.50



LUG MOUNTING (RG) CAPACITORS

	1-9	10+
R16585 8,000uF 75V..	$12.95	$9.95
R16587 10.000uF 75V..	$14.95	$10.95



LOW PROFILE IC SOCKETS

Save a small fortune on these "Direct import" low profile IC sockets! PCB mounting solder tail. All tin plated phosphor bronze or berryllium and dual wipe for reliability.

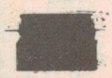
	1-9	10+	100+
P10550	8 pin 15¢	12¢	10¢
P10560	14pin 20¢	18¢	15¢
P10565	16pin 20¢	18¢	16¢
P10567	18pin 30¢	25¢	22¢
P10568	20pin 35¢	30¢	25¢
P10569	22pin 35¢	30¢	26¢
P10570	24pin 35¢	30¢	26¢
P10572	28pin 45¢	35¢	30¢

WIRE wRAP IC SOCKETS

These quality 3 level wire wrap sockets are tin plated phosphor bronze.

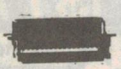
	1-9	10+
P10579	8pin $1.50	$1.40
P10580	14pin $1.85	$1.70
P10585	16pin $1.95	$1.80
P10587	18pin $1.95	$1.80
P10590	20pin $2.95	$2.75
P10592	22pin $2.95	$2.70
P10594	24pin $3.95	$3.50
P10596	28pin $3.95	$3.50
P10598	40pin $4.95	$4.50

IDC PLUGS AND SOCKETS FROM ONLY $2.20



D TYPE IDC PLUGS

	1-9	10+	100+
DE9P	9 pin plug		
P12166	$2.95	$2.50	$2.20
DA15P	15 pin plug		
P12168	$2.95	$2.50	$2.20
DB25P	25 pin plug		
P12170	$4.50	$3.95	$3.50



D TYPE IDC SOCKETS

	1-9	10+	100+
DE9P	9 pin socket		
P12167	$2.95	$2.50	$2.20
DA15P	15 pin socket		
P12169	$2.95	$2.50	$2.20
DB25P	25 pin socket		
P12171	$4.50	$3.95	$3.50

PC BOARD HOLDER

A must for all PCB work.

T12444.....$9.95

ECONOMY TRANSFORMERS

Description	1-9	10+
2155 240V 6-15V 1A		
M12155	$9.95	$8.95
2156 240V 6-15V A2		
M12156	$13.95	$12.95
2851 240V 12-6V CT 250mA		
M12851	$7.95	$6.95
6672 240V 15 30vc 1A tapped		
M16672	$12.95	$11.95

12V DC FANS

80 x 80 x 25.4mm
12V DC. 1.7 Watt 0.14 Amp
T12469.....$18.95
10+ fans, only $17.95

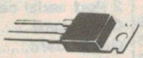
FANS

Quality fans for use in power amps, computer hotspot cooling etc. Anywhere you need plenty of air.

240V 4 5/8" T12461..$16.95
115V 4 5/8" T12463..$16.95
240V 3 1/2" T12465..$16.95
115V 3 1/2" T12467..$16.95

TOGGLE SWITCHES

	1-9	10+
S11010	S.P.D.T $1.20	$1.10
S11020	D.P.D.T $1.30	$1.20



ICB VOLTAGE REGULATORS

Description	1-9	10+	100+
7805UC	$1.00	$0.90	$0.75
7812UC	$1.00	$0.90	$0.75
7815UC	$1.00	$0.90	$0.75
7905UC	$1.00	$0.90	$0.75
7912UC	$1.00	$0.90	$0.75
7915UC	$1.00	$0.90	$0.75
78L05	$0.40	$0.30	$0.28
78L12	$0.40	$0.30	$0.28
LM324	$1.00	$0.90	$0.80
555	$0.75	$0.65	$0.60
741	$0.75	$0.65	$0.60

MINIATURE HOBBY VICE

- **Lever operated suction base grip for instant mounting & portability.**
- **Mounts on smooth non-porous surfaces**
- **Ideal for holding & other small objects .**

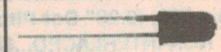
T12458.....$6.95

PCB MOUNTING SCREW TERMINALS

(INTERLOCKING ENDS)

These terminals feature interlocking ends to form any number of connections. Standard 5mm spacing pins.

P10520	2way		
	1-9	10_	100+
	$0.50	$0.40	$0.35
P10521	3 way		
	$0.75	$0.60	$0.50



QUALITY 3mm LEDS

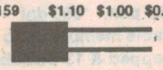
	1-9	10-99	100+	1K
1000+				
Z10140(R)	$0.15	$0.12	$0.10	$0.08
Z10141(G)..	$0.20	$0.18	$0.15	$0.12
Z10143(Y)..	$0.20	$0.18	$0.15	$0.12
Z10145(O)..	$0.20	$0.18	$0.15	$0.12

QUALITY 5mm LEDS

Z10150(R).	$0.15	$0.12	$0.10	$0.08
Z10151(G).	$0.25	$0.20	$0.18	$0.12
Z10152(Y)..	$0.25	$0.20	$0.18	$0.12

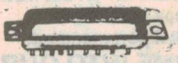
FLASHING LEDS

RED 5mm	1-9	10+	100+
Z10159	$1.10	$1.00	$0.80



RECTANGULAR LEDS

	1-9	10+	100+	1K
RED	20¢	15¢	12¢	10¢
GREEN	20¢	15¢	12¢	10¢
YELLOW	20¢	15¢	12¢	10¢



DB25 CONNECTOR SPECIALS

	1-9	10+	100+
P10880 DE9P	$1.00	$0.80	$0.60
P10885 DE9S	$1.00	$0.70	$0.60
P10891 DA15S	$1.00	$0.70	$0.60
P10892 DA15C	$1.00	$0.90	$0.60
P10895 DA15S	$1.00	$0.80	$0.60
P10902 DB25C	$1.00	$0.80	$0.60
P10904 DB25P	$1.00	$0.80	$0.60
P10905 DB25S	$1.00	$0.80	$0.60

DO YOU NEED A UART? "SCOOP PURCHASE" 16C450 (82450)

Features of the UART include programmable data, format parity, framing and overrun error detection etc.

1-9	10+
U22185..... $7.95	$6.95

TRANSISTORS BUY IN BULK & SAVE!

	1-9	10+	100+
BC 547	$0.15	$0.10	$0.07
BC 548	$0.15	$0.10	$0.07
BC 549	$0.15	$0.10	$0.07
BC 557	$0.15	$0.10	$0.07
BC 558	$0.15	$0.10	$0.07
BC 559	$0.15	$0.10	$0.07
BC 327	$0.20	$0.15	$0.12
BC 337	$0.20	$0.15	$0.12
BD 139	$1.20	$1.10	$1.00
BD 140	$1.20	$1.10	$1.00

ELECTRET MIC INSERTS

With Pins for easy board insertion.
10mm diameter,
10 mm high.
C10170

1-9	10+	100+	1000+
$1.70	$1.50	$1.20	$0.80

MINI MIC INSERT
Omnidirctional mini mic insert, 6mm diameter.
7mm high
C10165

1-9	10+	100+	1000+
$2.00	$1.80	$1.30	$1.00

USE YOUR LOGIC & SAVE "MULTI" DOLLARS ON MULTIMETERS & LOGIC PROBES

HUGE MULTIMETER SALE

SPECIAL OFFER

Buy two or more multimeters and receive an extra 10% off the price! But Hurry stock is very limited. Please have a second choice handy in case your first choice is unavailable.

SAVE $10

LOGIC PROBE (LP-2800)
Useful for TTL and CMOS

High & low indicators pulse memory. For the hobbiest or serious technician for tracing those hard to find faults on logic boards **Q11272 Was $29.95**

Sale price $14.95

KITS....KITS....KITS

WE HAVE A LARGE RANGE OF KITS TO CHOOSE FROM AND THE LIST IS GROWING ALL THE TIME! FOR THE LATEST AVAILABLE KITS PHONE (03) 543 7877.

CAT	Description	R.R.P
K10005	SOLAR VOLTAGE REGULATOR	$13.95
K10040	ETI 480 50W AMP	$27.95
K10045	ETI 480 100W AMP	$34.95
K10050	ETI 480 POWER SUPPLY	$26.95
K10055	GENERAL PURPOSE PRE-AMPLIFIER	$14.95
K10060	BALANCED MICROPHONE AMPLIFIER	$12.95
K10065	GENERAL PURPOSE AMPLIFIER	$14.95
K10070	BALANCED INPUT DIFFERENTIAL PREAMP	$19.95
K10075	FLOAT NICAD CHARGER	$14.95
K10080	TRANSISTOR TESTER	$22.95
K10085	300W PLAYMASTER AMP	$119.00
K10085	2 TONE ALARM	$9.95
K10100	1.5V TO 9V DC CONVERTER	$13.95
K10105	3 DIGIT COUNTER	$23.95
K10110	ELECTRIC FENCE	$23.95
K10115	ELECTRIC FENCE CONTROLLER	$61.95
K10120	TV PATTERN GENERATOR	$109.00
K10125	UNIVERSAL POWER SUPPLY	$12.95
K10130	DISCO LIGHT	$165.00
K10135	LED SCANNER	$17.95
K10140	LOW FUEL INDICATOR FOR CAR	$11.95
K10145	SCREECHER CAR ALARM	$36.95
K10150	12/24V LIGHT CHASER	$21.95
K10155	LOW VOLTAGE CUTOUT FOR CAR / BOAT	$22.95
K10200	50 MHz DIGITAL FREQUENCY	$1495
K10205	VHF POWERMATCH	$74.95
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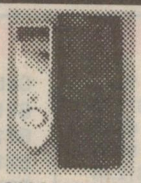

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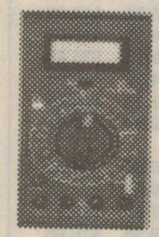

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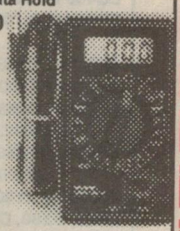

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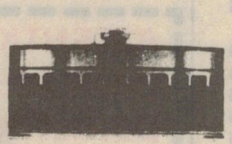

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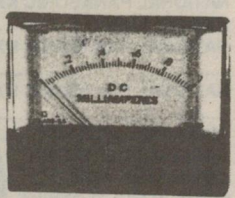

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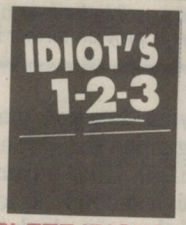

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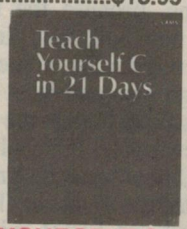

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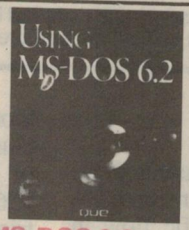

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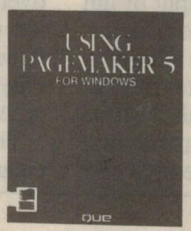

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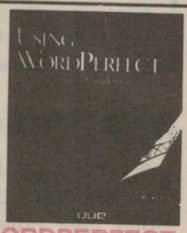

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Circuit & Design Ideas

Interesting circuit ideas from readers and technical literature. While this material has been checked as far as possible for feasibility, the circuits have not been built and tested by us. We therefore cannot accept responsibility, enter into correspondence or provide further information.

Model traffic lights

Model traffic light circuits are nothing new, but many designs lack 'realism' — either they only control traffic flow in one direction, or they don't have genuine light patterns. This circuit gives independent control over the length of traffic flow in both directions, which is variable from seconds to minutes.

You can also vary the yellow 'caution' interval, and there is a 2s overlap while both lights show red.

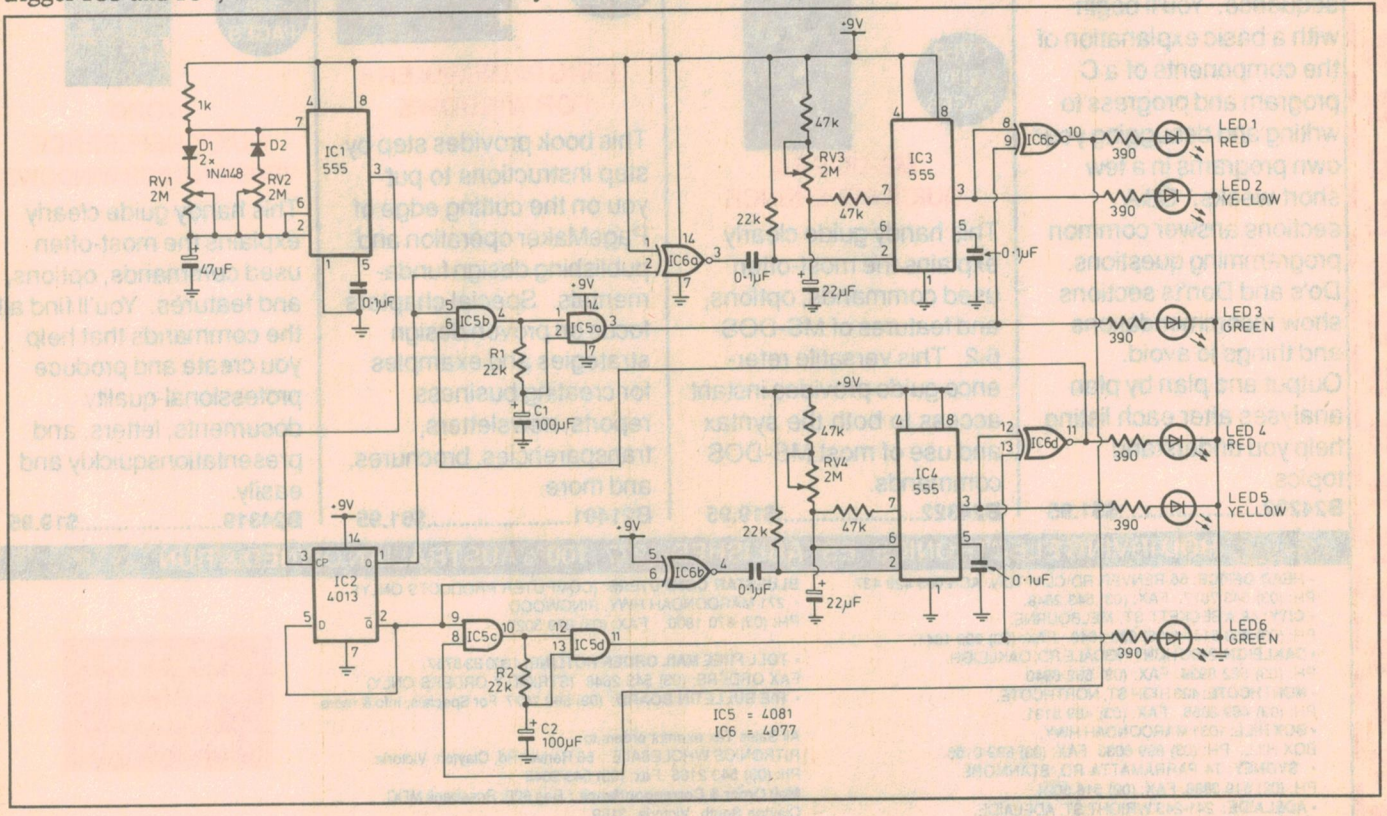
IC1 is a 555 configured as an astable multivibrator, with RV1 and RV2 giving independent adjustment over high and low output periods. This controls the length of time that traffic flows in either direction. The ouput (pin 3) from IC1 is used to clock IC2 (4013), which is half of a dual D flipflop. IC2 is wired as a 'T' flipflop, by connecting the output of pin 2 to the D pinput on pin 5. The two outputs on pins 1 and 2, which are always in opposite states, will alternate on the positive edge of each clock pulse. These two outputs, buffered by IC6, are used to trigger IC3 and IC4, which are both 555 monostables. IC6 (4077) is a quad exclusive NOR gate. So when the Q output of IC2 goes low, the output (pin3) of IC6a also goes low. This negative pulse triggers IC3.

Similarly, the Q-bar output triggers IC4 via IC6b. The 555s' timing periods can be varied with RV3 and RV4, thus altering how long each caution signal (LED2 or LED5) is on before the respective traffic light turns to red. This gives a more realistic time frame, as the yellow LED can show longer for the set of lights controlling the heavier traffic flow. IC5 is a 4081 quad AND gate. Gates a and b are used to turn on the green LED3, after a 2s delay, while gates c and d perform the same operation for green LED6. The delay periods are controlled by the time constants R1/C1 and R2/C2, and have the effect of overlapping the time that both red lights are on. The XNOR gates IC6c and IC6d are set up to turn on the red LEDs only when their respective yellow and green LEDs are both off.

The interaction of the circuit is more clearly seen if we follow through a complete cycle. Imagine that light set 1 is showing green (LED3) and light set 2 is red (LED4). This means that pin 1 of IC2 is high and pin 2 is low. The positive edge of the next clock pulse from IC1 now alternates IC2's outputs:

Pin 1 goes low, which immediately affects the lights on set 1. The low turns off green LED3 and also triggers IC3 via IC6a, turning on yellow LED2. At the same time, pin 2 of IC2 goes high, but has no immediate effect on the lights of set 2. At the end of IC3's monostable timing period, pin 3 goes low and turns off yellow LED2; at the same time, because the two inputs to IC6c are now both low, pin 10 goes high and the red LED1 comes on. Pin 10 going high also activates IC5c, because pin 9 has been high since the beginning of the new cycle. IC5c's high output on its pin 10 now turns on green LED6 via IC5d, after the 1s delay (R2/C2). Green LED6 and red LED1 will continue to glow, until the arrival of the next clock pulse at IC2 starts the next cycle.

Phillip Gamble,
Frankston, Vic. **$45**



Audio attenuator design

Our company designs commercial electronic equipment, both hardware and software, for original equipment manufacturers.

Recently we needed an audio attenuator to allow us to verify the operation of a microprocessor-controlled telemetry unit. The testing involved checking for a known level change in received audio level. Since our function generator didn't provide us with a simple solution for a fixed level change, we designed and built our own audio attenuator box.

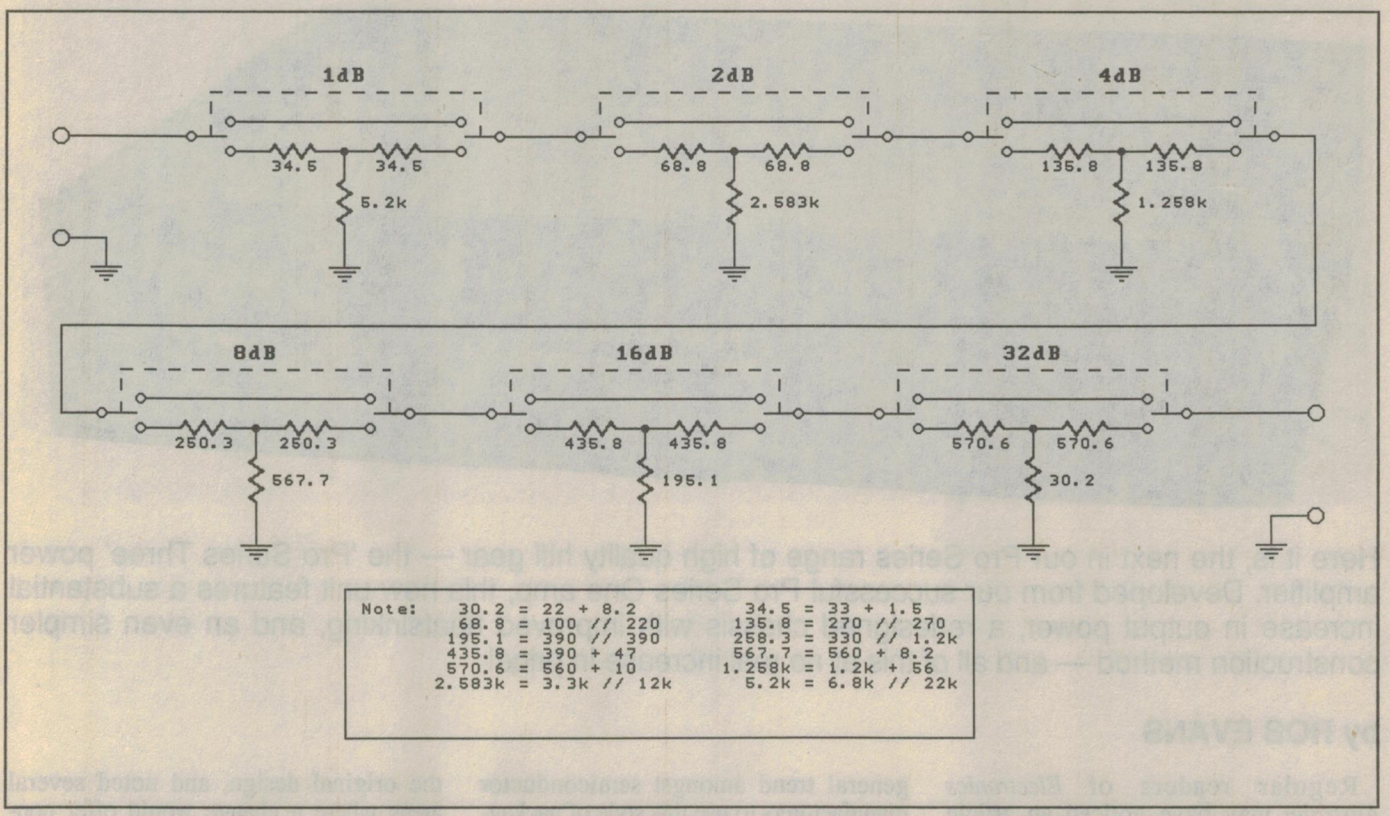
To maximise its usefulness, it has been expanded to allow for any value of attenuation between 0dB and 63dB, with 1dB resolution. I wrote a couple of 'quick and dirty' QBasic programs to facilitate the calculations of the attenuator components and the resistor combinations (using standard E12 resistor values).

The second program is a modification of one which appeared in *elektor* in July/August 1984. I have further modified this program to allow calculations for E24 resistors. Using these programs, it would be a simple job to rework the component values to suit impedances other than 600 ohms, and for other attenuation values.

The attenuator prototype was built into a small jiffy box with binding posts for input and output terminations, and DPDT slide switches to control the attenuator steps.

Rod Egan,
Hamersley, WA. **$40**

Editor's note: The three programs mentioned above are available in both QBasic and QuickBASIC compiled form from our Reader Services Division. To obtain a copy, send an MS-DOS formatted 5-1/4" disk and the usual $7.50 handling fee.



Note:

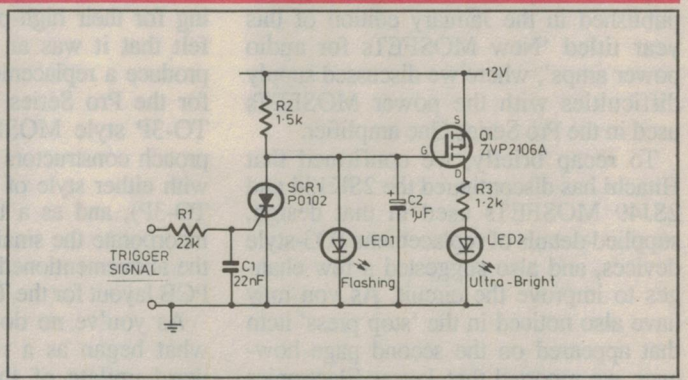
30.2	= 22 + 8.2	34.5	= 33 + 1.5
68.8	= 100 // 220	135.8	= 270 // 270
195.1	= 390 // 390	258.3	= 330 // 1.2k
435.8	= 390 + 47	567.7	= 560 + 8.2
570.6	= 560 + 10	1.258k	= 1.2k + 56
2.583k	= 3.3k // 12k	5.2k	= 6.8k // 22k

Flashing lamp driver

As a deterrent to burglars, I decided to incorporate a flashing lamp mounted on the external control panel of my alarm. I considered using a flashing LED but this was not bright enough to attract attention in bright daylight. Also, I needed a lamp which could change to continuous mode to indicate that the alarm had been triggered.

I decided to use one of the new ultra-high brightness LEDs (3000 millicandela), and hit on the idea of using the flashing LED as a simple oscillator. Its 2Hz flashing rate is ideal. By using a 12V supply rail, and placing a 1.5k resistor (R2) in series with LED1, the voltage across the LED alternates between 3.3V and 12V as LED1 flashes on and off. This applies a voltage of 8.7V and 0V between the gate and source of the enhancement-mode P-channel MOSFET Q1, which turns the transistor on and off to flash the ultra-bright LED2. (I used a ZVP2106A for Q1, though any similar device should do.)

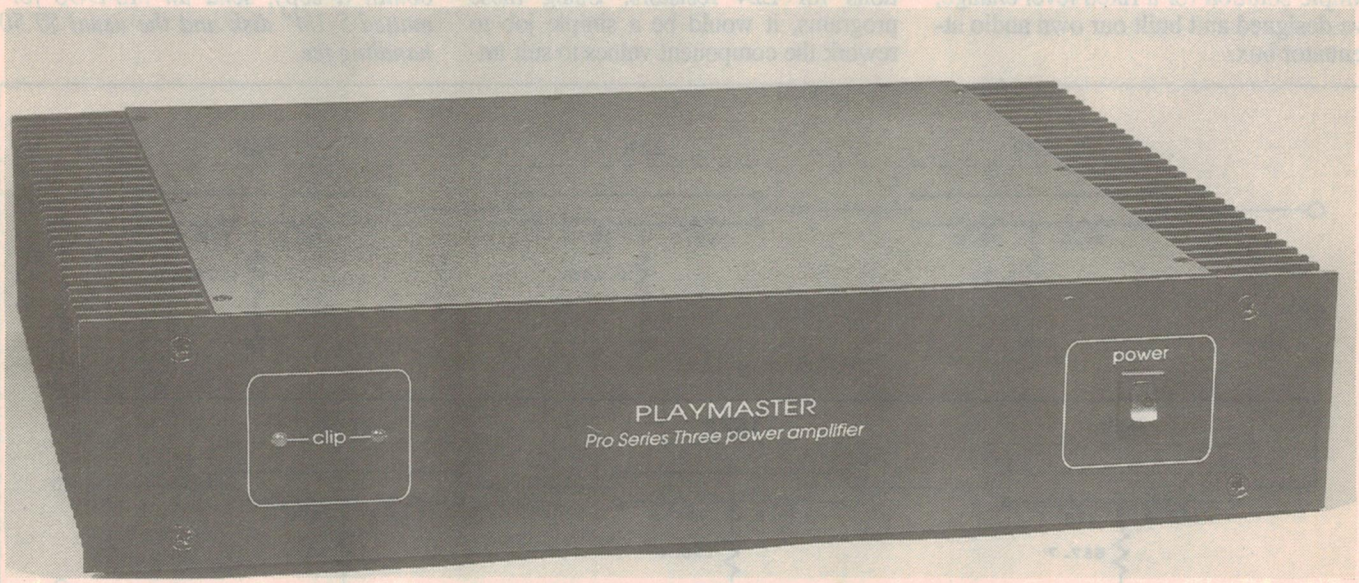
In order to change to continuous mode, SCR1 (PO102) needs to be triggered. In my case, the trigger signal is taken from across the siren, so that it only goes high when the alarm is activated. When the SCR is triggered, the gate of transistor Q1 falls to nearly 0V and stays there; so the ultra-bright LED2 shines continuously until the system is switched off.



Mario Annetta,
Reservoir, Vic. **$40**

Construction project:

New high performance Playmaster power amp — 1



Here it is, the next in our Pro Series range of high quality hifi gear — the 'Pro Series Three' power amplifier. Developed from our successful Pro Series One amp, this new unit features a substantial increase in output power, a redesigned chassis with improved heatsinking, and an even simpler construction method — and all of this at no real increase in price!

by ROB EVANS

Regular readers of *Electronics Australia* may have noticed an article published in the January edition of this year titled 'New MOSFETs for audio power amps', where we discussed supply difficulties with the power MOSFETs used in the Pro Serics One amplifier.

To recap briefly, we confirmed that Hitachi has discontinued the 2SK134 and 2SJ49 MOSFETs used in that design, supplied details of replacement TO3-style devices, and also suggested a few changes to improve the circuit. As you may have also noticed in the 'stop press' item that appeared on the second page however, we reported that Jaycar Electronics had secured a source of the official Hitachi replacement devices, which are electrically equivalent to the old MOSFETs but enclosed in the newer large plastic TO-3P package.

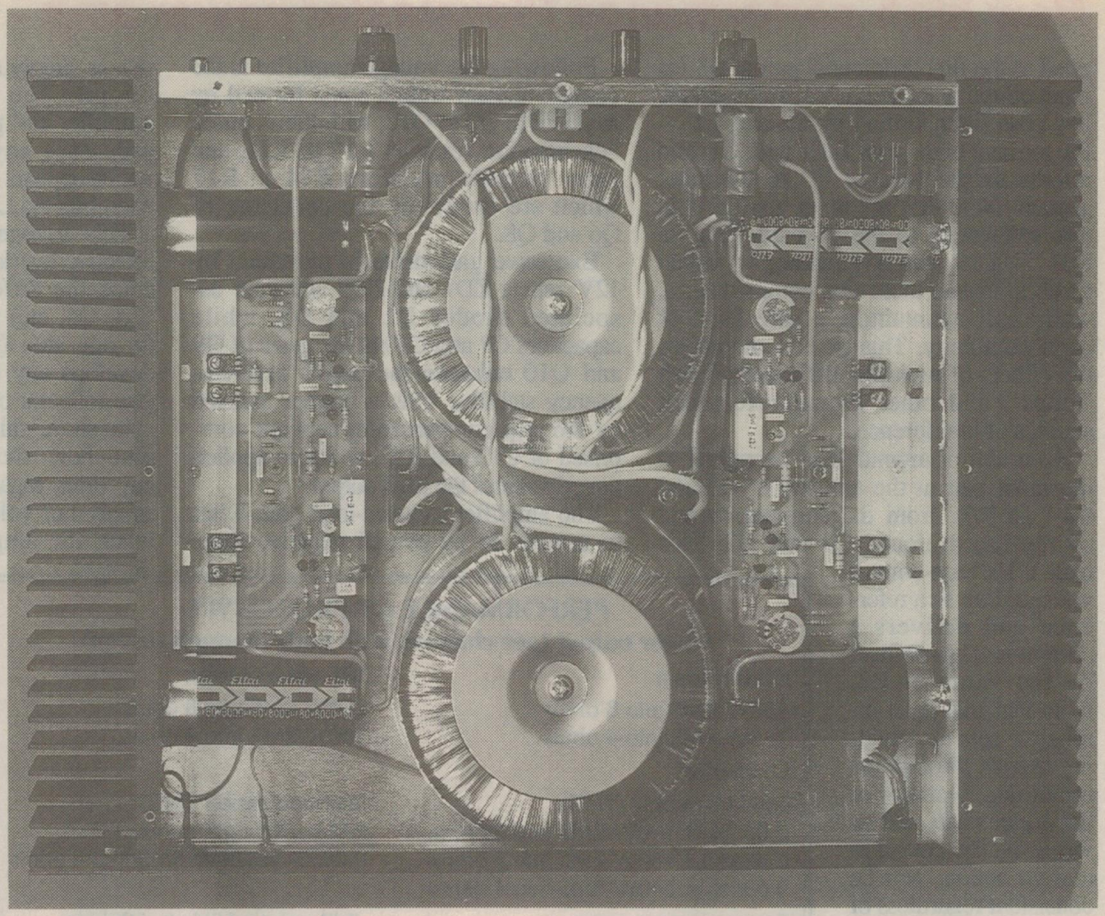
In the light of this fact — plus the general trend amongst semiconductor manufacturers to use this style of packaging for their high-power devices — we felt that it was an appropriate time to produce a replacement amplifier module for the Pro Series One, using the new TO-3P style MOSFETs. With this approach constructors could build the amp with either style of MOSFET (TO- 3 or TO-3P), and as a bonus we could also incorporate the small changes detailed in the abovementioned article, into the new PCB layout for the TO-3P version.

As you've no doubt gathered though, what began as a relatively straightforward update of the Pro Series One's amplifier module soon progressed into the new improved design presented here — the Pro Series Three power amp.

We should point out at this stage that this more ambitious development came about only after we took a careful look at the original design, and noted several areas where a change would offer constructors even better value for money — it certainly wasn't just change for change's sake.

This rationalising process was greatly assisted by Jaycar themselves, who as well as tracking down supplies of the new flatpack MOSFETs, also noted that both the 225VA transformers and cast front panel were taking an unreasonable share of the Pro Series One's purchase price. On the strength of this, it became apparent that 300VA transformers could be used in the new design without a price penalty, since as a 'stock' item they are no more expensive that the 225VA units. We were also able to have a fresh look at the design of the amplifier's case.

To cut a long development story short, we were then able to produce an improved box design based around a set of



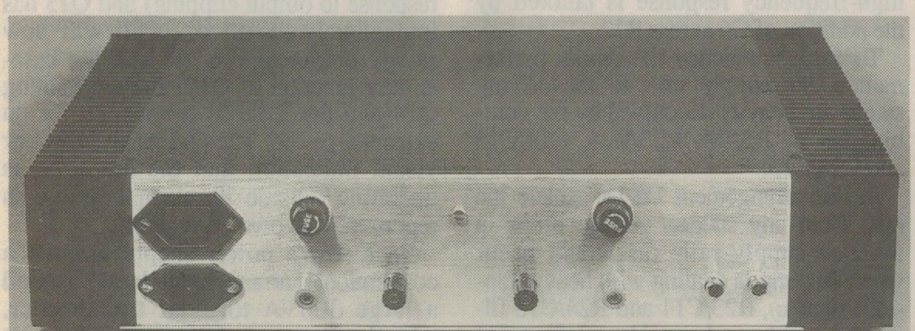
The new amp uses two large 300VA toroidal power transformers, and a set of deep finned heatsinks which double as the sides of the box. Note how the amplifier modules and main filer capacitors mount directly to the heatsink surfaces.

large high-efficiency heatsinks, harness the extra power available from the huskier power transformers, and take the opportunity to streamline several parts of the design.

We'd like to thank the energetic folk from Jaycar's kit department for their assistance with the box design in particular, by the way. This was crucial part of the new amp's development and has undoubtedly led to a more cost-effective result.

The final design for the new Pro Series Three uses virtually the same circuit as the Pro Series One, but with the supply rail voltage increased from +/-69V to +/-75V; a slight change in the input earthing arrangement; and a modified overload LED driving circuit — plus of course, the minor alterations detailed in the MOSFET update article in the January issue. The end result is that the new Pro Series Three amp should cost you no more than the past design, yet offers around 30% more power with the same impressive specifications (see 'Performance of Prototype' box).

Also note that thanks to the MOSFET's new TO-3P package, we were able to produce an even smaller circuit board, and derive a much simpler method for mounting both the MOSFETs and the complete amplifier module. So all in all, we're very pleased with the result — it's simpler to put together, and offers far more 'bangs per buck' (as they say).



The rear of the amp holds the usual array of input/output sockets and a separate 240V AC fuseholder for each channel — the speaker connectors really should be larger than those used in the prototype.

The circuit

As mentioned above, the new amplifier's design is virtually identical to that of the Pro Series One, so for this article we'll just recap on the operation of the the circuit's various stages without recovering every aspect of why particular devices and configurations have been used.

Those who would like more information on these aspects should refer to the first instalment of the Pro Series One article, which appeared in the December 1989 issue of *EA*. This also includes a discussion on the advantages of a MOSFET-based output stage, by the way.

As you can see from the schematic diagram, the circuit's input stage is formed around a differential amplifier based on Q3 and Q4, which directly drives a high-gain voltage amp based on another differential pair, Q5 and Q6. This in turn drives a very simple output stage formed by two sets of complementary power MOSFETs (Q9 to Q12), which functions as a high-gain current amplifier.

In more detail, the input signal is ap-

plied to the first differential pair at Q3 via input coupling capacitor C1, and a simple low-pass filter formed by R2 and C2 — R1 forms a high- pass filter with C1, and references the base of Q3 to the input ground. Note that the input ground is in turn referenced to the 0V/earth line via R31 — a 10 ohm 5W resistor — which tends to isolate these two common lines, while still maintaining a safe level of earth continuity. This in turn minimises the effects of multiple earth paths (earth 'loops') and other ground-referenced sources of interference.

A current of around 1mA is applied to the input pair at the emitters of Q3 and Q4 (via R5), from the constant current source based around Q1 and Q2. This uses Q1's base-emitter voltage drop as a reference and delivers a current level as defined by the value of R3. Note that this level ultimately sets the standing current through the remaining sections of the driver stage, and by virtue of the constant-current action, will be consistent regardless of other external effects such as variations in the supply rail voltage.

The input stage drives load resistors R6 and R7, which are directly coupled to the following voltage amplifier section based on the differential pair Q5 and Q6, which drive a balanced 'current mirror' load formed around Q7 and Q8. This stage supplies most of the circuit's voltage gain, and its output at the collector of Q6 is capable of swinging between both supply rails in an extremely linear manner.

The other 'house-keeping' components around this stage include the shared emitter resistor R13, the current mirror load resistors R9 and R10, and Q5's collector resistor R11 which reduces the power dissipation in Q5 to a similar level to that of Q6 — C5 is used to bypass this resistor at high frequencies, by the way. Also present are the quiescent current trimpot RV1 and its bypass capacitor C7, and compensation capacitor C8 which acts to reduce the amp's open-loop gain at very high frequencies (single-pole lag compensation), thereby ensuring its overall stability.

Following the voltage amplifier is the complementary output stage formed by MOSFETs Q9 to Q12, with their source degeneration resistors R18 to R21, and gate 'stopper' resistors R14 to R17 which are driven by the collectors of Q6 and Q8.

Excessive gate drive is prevented by 12V zeners ZD1 and ZD2 and their associated diodes D1 and D2, while capacitors C9 and C10 at the gates of Q9 and Q10 enhance the amp's high-frequency stability. This is further assisted by the step compensation network comprised of C12 and R22, which is applied directly across the final output.

The amplifier's closed-loop gain is set to around 34 by overall negative feedback, applied to the base of Q4 via the network formed by the combination of R12, R8 and C4. Here, C3 is placed in parallel with decoupling capacitor C4 to maintain the path to ground at higher frequencies, and the amp's closed-loop high-frequency response is tailored by the addition of C6 across R12.

To further enhance the amp's performance, the supply rails to the driving stages are heavily decoupled by the combination of D3/D4, R23/R24, C14/C16 and C13/C15.

In this arrangement D3/D4 isolate the rails from any sudden voltage drops in the raw supply rails (as would occur when the amp is dealing with heavy transient signals), R23/C14 and R24/C16 filter the supply and provide a 'reservoir' for each rail, and C13/C15 provide high-frequency bypassing.

The final parts of the circuit involve the power supply and overload LED driving circuit. The latter is really just an amplifier and pulse stretcher, and simply processes any substantial AC signal which appears at the collector of Q5, then energises the LED accordingly.

This arrangement can work as a very effective overload indicator in our circuit since the differential voltage amplifier (Q5, Q6, etc) produces its output signal on one side (the collector of Q6), yet develops any *error signal* on the other (the collector of Q5).

In short, this error signal will represent how the amp is performing at any time, regardless of load impedance, supply rail voltage, and so on. Note that when the amp is operating within its limits this signal will be very small in amplitude, but will increase dramatically in size if (say) clipping occurs.

The overload LED driving circuit used to sense this signal is based around Q13 and Q14, where Q13 is configured as a simple common emitter amplifier, and receives the error signal via isolating resistor R25 and AC coupling capacitor C19. When Q13 is biased on due to a positive-going input signal, its rapid increase in collector current both quickly charges C20 via R27, and biases Q14 hard on via R28 — which in turn energises the overload indicator (LED1) via R30.

Assuming that the input signal was momentary by nature (say, a 'spike' in response to output clipping) and Q13 has immediately turned off, C20 will now slowly discharge via R28 and the base-emitter junction of Q14, thereby holding Q14 and the LED in conduction for an extended period. The end result is a clear visual indication that the amplifier is operating outside its normal limits, as reported by its own error signal.

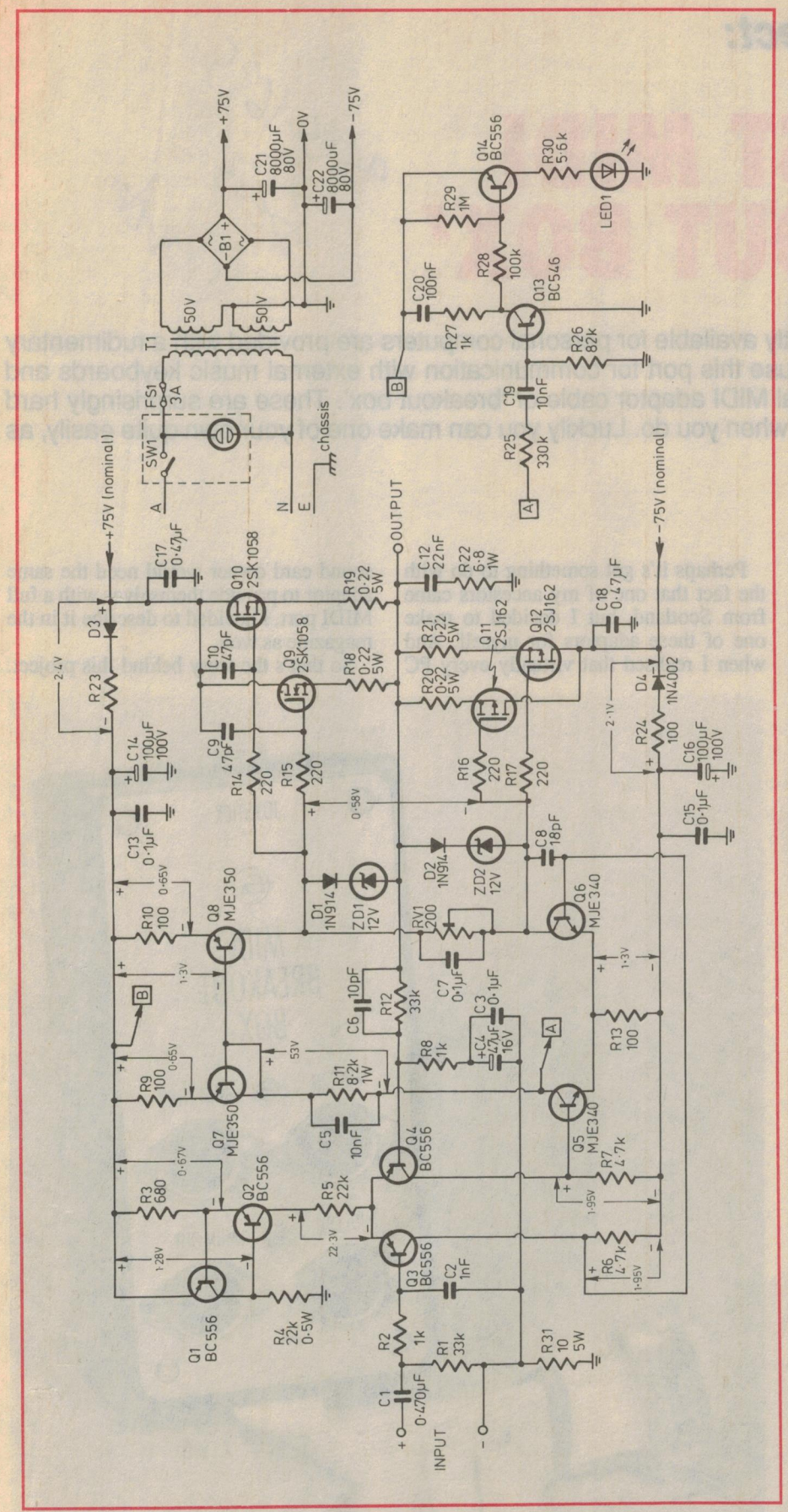
Each amp's power supply is quite a conventional arrangement based around a large 300VA toroidal transformer, which offers two (nominally) 50 volt secondary windings.

These then feed a heavy-duty bridge rectifier B1, and the resulting balanced

PERFORMANCE OF PROTOTYPE

Power output (per channel, with both channels driven)

Continuous:	**IHF (short term):**
185W RMS into 8 ohms	240W RMS into 8 ohms
255W RMS into 4 ohms	380W RMS into 4 ohms
Distortion	
Total Harmonic (THD):	Intermodulation (IMD):
0.005% at 100W RMS into 8 ohms	(50Hz/7kHz 4:1 ratio)
0.008% at 180W RMS into 8 ohms	0.005% at 180W RMS into 8 ohms
0.009% at 240W RMS into 4 ohms	
Frequency response	-3dB points: 10Hz to 100kHz
Signal to Noise ratio (unweighted)	>100dB with respect to 100W RMS
Slew rate	Approx 40V/us (defined by input filter)
Damping factor	>300 at 180W RMS into 8 ohms
Input sensitivity/impedance	0.8V/33k for 100W into 8 ohms
Overload indicator	Activated if output THD exceeds approx 0.05% (regardless of load impedance)



Despite the beefed up power supply and a few minor changes to the design, the amplifier's circuit is very similar to that of the earlier Pro Series amp.

supply rails are filtered by 8000uF/80V reservoir capacitors C21 and C22. Note that the transformer's 50-0-50 VAC rating refers to the expected secondary voltage when the winding is delivering its rated current (around 3A for a 300VA unit), and this will be a little higher under static conditions. In our case, the transformer delivers about 53VAC per secondary winding when the amplifier is idling, resulting in nominal supply rails of +/-75VDC.

To kit or not?

As with most of the other more complicated construction projects described in *EA*, we expect that most readers wishing to build the new Pro Series Three amp will elect to purchase a kit of parts from one of the major resellers, such as Jaycar Electronics.

For this project in particular we would recommend that you follow this path, as some of the more specialised parts may be a little difficult to find, and you can save yourself considerable effort (and skinned knuckles) by assembling the case from a kit's pre-cut and drilled panels. And of course, the kit is likely to include pre-prepared front panel artwork, which will result in professional looking finish.

On the other hand, it's certainly possible to build the project up from scratch once you've secured the necessary parts, and as we've seen from a number of dedicated constructors, the results can be very impressive indeed. To this end, we've included all relevant artwork (PCB and front panel) for the project, so that those who 'roll their own' will have the necessary details.

Note that we haven't included detailed drawings for the box panels however, since those in the prototype were made to suit the heatsinks provided by Jaycar — unfortunately, these heatsinks are not a standard off-the-shelf retail item, so there would be little point in describing their matching panels.

Nevertheless, those with metalworking experience would be able to build a case to suit a set of alternative heatsinks in short order, and provided those heatsinks have sufficient cooling capacity, the resulting amplifier should perform just as well as the prototype.

So all in all, a kit is probably the way to go for those planning to build the new Pro Series Three amp — you'll be supplied with all of the necessary parts in one hit, including a chassis which should be very easy to assemble.

That's about all we have space for in this issue. In our next instalment, we'll deal with the Pro Series Three's construction and setting up procedure. ❖

Contruction project:

LOW COST MIDI 'BREAKOUT BOX'

Many of the sound cards currently available for personal computers are provided with a rudimentary MIDI port. However in order to use this port for communication with external music keyboards and synthesisers, you need a special MIDI adaptor cable or 'breakout box'. These are surprisingly hard to find, and generally not cheap when you do. Luckily you can make one of your own quite easily, as this article explains.

by JIM ROWE

Like many 'do it yourself' projects, this little design arose directly from a personal need. When I bought a sound card for my PC recently, in order to experiment with computer music and 'multimedia', I discovered that the card's so-called 'built in MIDI port' really only provided the *start* of what you need for a standard MIDI (musical instrument digital interface) port.

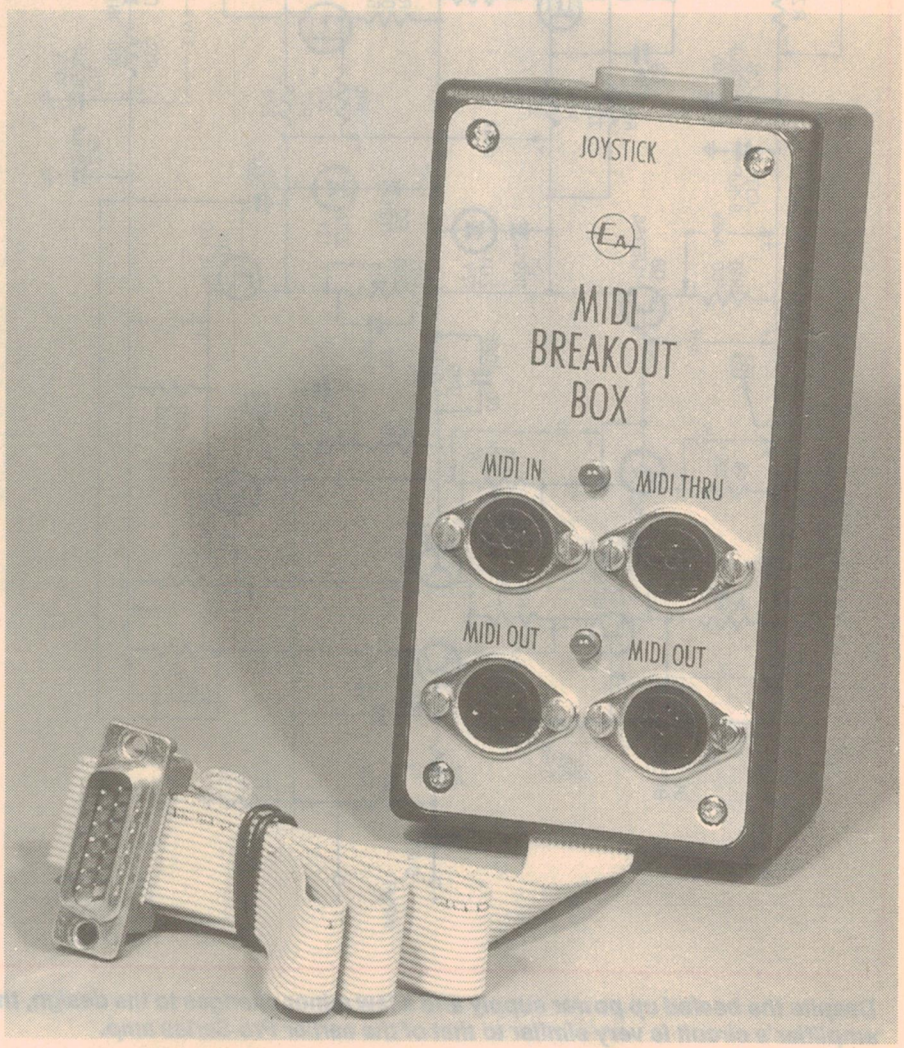
All it provided was a suitable serial-communications UART, with its serial-in and serial-out lines brought out to pins on a slightly modified version of the standard 15-pin PC 'games' or joystick connector. There was no output driver for the standard MIDI 5mA current-loop circuit, no opto-isolated current loop input, no standard 5-pin DIN connectors. In other words, no way you could connect it directly to a standard MIDI instrument or external synthesiser, etc.

It turned out that if you wanted to do this, you were supposed to buy a separate adapter cable or 'breakout box', which provides all of the missing circuitry and connectors. The cost of these was quoted as anywhere from $75 to $199 — and they were only available on special order.

I gather much the same situation applies with most other sound cards — including the Sound Blaster series, which are the most widely used of all. In fact this approach seems to have become the standard among just about all PC sound cards. They provide a pair of pins on a modified joystick connector, but if you actually want a full standard MIDI port you need to augment this rudimentary setup with one of the adaptor cables or adaptor boxes.

Perhaps it's got something to do with the fact that one of my ancestors came from Scotland, but I decided to make one of these adaptors for myself. And when I realised that virtually every PC sound card owner would need the same adaptor to provide themselves with a full MIDI port, I decided to describe it in the magazine as well.

So that's the story behind this project.



The prototype has been working for a couple of months now, and seems to do everything needed for basic MIDI work with a PC sound card. It provides the PC with a standard isolated MIDI IN, two standard 5mA MIDI OUTs (to feed two instruments with the same signal), and even a MIDI THRU connector providing a buffered replica of the MIDI IN signal. As a bonus, it also provides LED indicators so you can monitor MIDI activity on the IN/THRU and OUT sides of the interface.

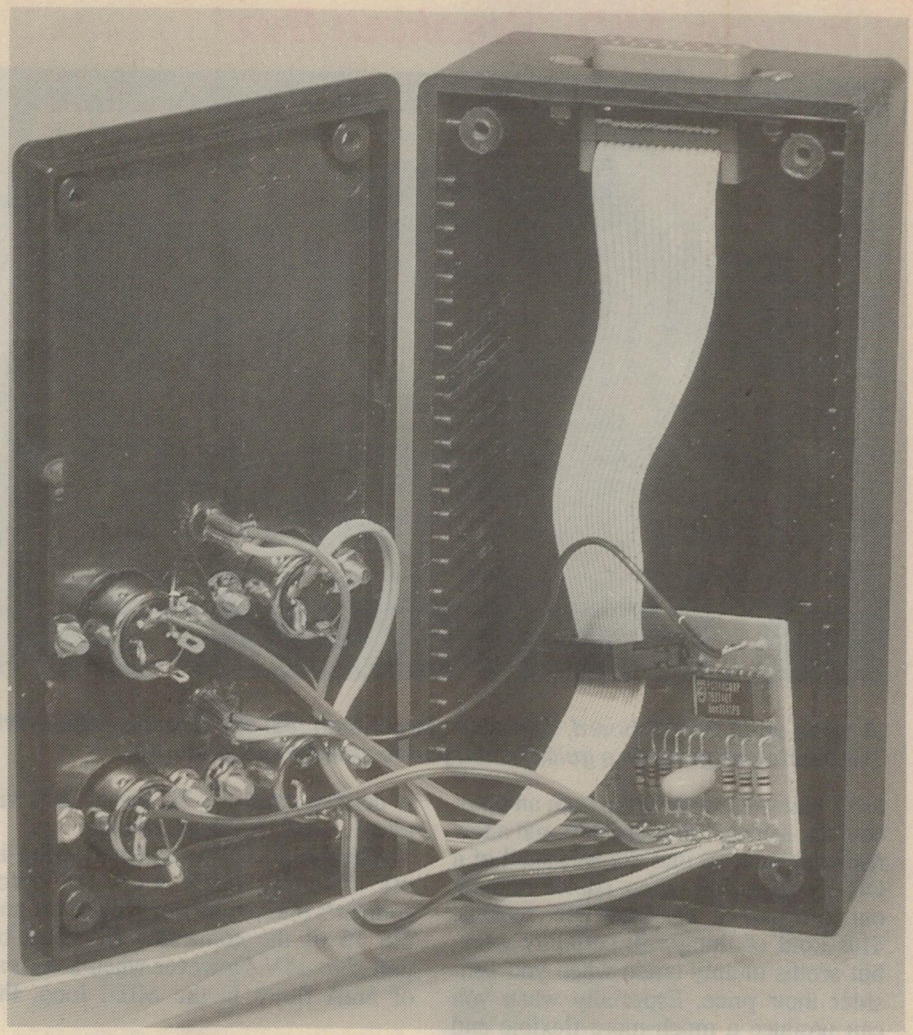
All of this is achieved with only two readily-available chips and a handful of other low cost parts, in a small jiffy box — which even provides a duplicate of the sound card's 15-pin joystick socket, so your computer's ability to play games is not affected. The whole thing only needs a few tens of milliamps at +5V, and gets this power from the PC itself via the sound card's joystick port...

MIDI recap

I won't attempt here to give you a full introduction to MIDI; that's been done well many times before, by other people. If you do need a good basic introduction, I can recommend the article 'Inside MIDI' by Rob Evans, which we published in the January 1988 issue of *EA*. Copies are available via the Reader Information Service for $7.50, if you can't get access to one otherwise.

For the present, the main things to know are these:

1. MIDI uses serial data communication between computers and musical instruments, at 31.25kbps (kilobits per second).
2. Each MIDI data cable provides only one-way communication, via signalling in a 5mA current loop, with the signalling current provided by the 'transmitting' end.
3. Unlike other current-loop signalling, current only flows in a MIDI link when data is actually being sent, (i.e., MIDI uses 'spacing on idle', not 'marking on idle'). This allows cables to be connected and disconnected without any problems, providing data is not actually being transmitted at the time.
4. All MIDI connections are made via standard five-pin (180°) DIN connectors, with all equipment having female sockets and all cables male plugs. However *only* pins 4 and 5 of the connectors are used for the actual current loop signalling. Pins 1 and 3 are left unconnected, and pin 2 is connected to earth on the MIDI OUT sockets of equipment, to allow earthing of cable shield braids.
5. To prevent equipment damage due to wiring errors, component faults, static electricity or mains transients, all MIDI inputs are normally provided with full electrogalvanic isolation via an opto-coupler rated to withstand up to 3kV.
6. For correct MIDI communication between two pieces of equipment, the MIDI OUT or MIDI THRU socket at the transmitting end must be connected to the MIDI IN socket at the receiving end.
7. Many simple MIDI systems have a single controller or sequencer device (often a computer, nowadays), with other MIDI equipment such as keyboards, synthesisers, etc., connected to its inputs and outputs as appropriate. The connections between the controller and the other equipment can be made in 'daisy-chain' fashion, using the MIDI THRU connectors, or in 'star' fashion by making use of multiple MIDI OUT connectors.



Inside the box, most of the parts are mounted on a very small PC board which fits neatly on the bottom. The only exceptions are the four DIN sockets, two LEDs and the DB-15 socket used to 'relay' the sound card's joystick port.

These seem to be the basic concepts involved in simple MIDI systems of the kind based around a PC. There's no need to worry much about the actual codes sent over the MIDI links, because nowadays this is all handled by the software running on the PC itself, and the firmware inside the instruments.

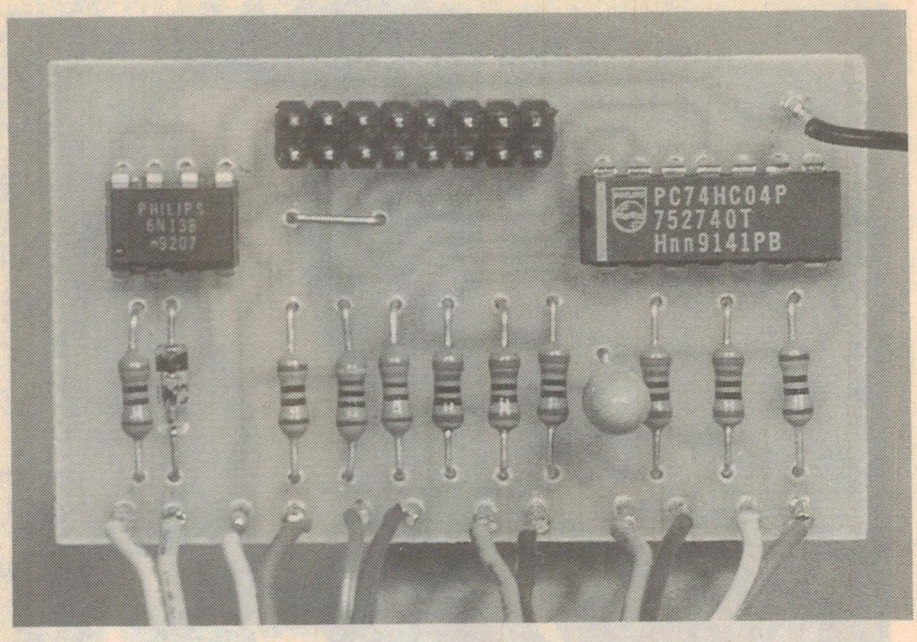
The circuit

As far as I have been able to determine, just about all of the commonly available sound cards use pins 12 and 15 of their modified joystick connector, for the 'MIDI port' connections.

Essentially pin 12 is the serial output from the card's UART chip, and pin 15 is connected to its serial input. So pin 12 provides a CMOS logic level version of the MIDI port output signal, and pin 15 expects the MIDI input signal in similar form. Hence the need for extra circuitry, to interface these with standard MIDI current loops.

Some of the simplest 'adaptor cables'

Low cost MIDI 'Breakout Box'



A close up of the PC board, somewhat larger than real life. Use it together with the overlay diagram as a guide, when you're assembling your own.

use a bare-minimum setup with an opto-coupler, a couple of transistors and a few resistors jammed into the backshell of a DB-15 plug, with short cables running out to a pair of line-type DIN sockets. This kind of thing will certainly work, but seems unduly crude when you consider their price. Especially when you can produce a much more flexible and professional unit, for only a very small increase in complexity and price. The whole unit described here should cost less than $45.

As you can see, the simple unit shown here involves only one low-cost chip apart from the 6N138 opto-coupler — a 74HC04 hex inverter chip. The 6N138 (U1) provides the safety isolation for the input, while the 74HC04 (U2) provides the buffering and current drive capability for the MIDI outputs.

The MIDI input circuit is quite standard, with pins 4 and 5 of the socket connecting to the opto-coupler LED via a current limiting 220 ohm resistor (R1). Diode D1 is to protect the LED in the (unlikely) event of a wrongly-wired MIDI cable. The output phototransistor of the coupler is connected as a simple switch, with its emitter grounded and its collector connected to pin 15 of the sound card connector — the serial input of the MIDI port UART.

In addition, the pin and collector are connected to the +5V power line, via resistor R1 and R2 in series with the MIDI IN/THRU LED. The +5V rail is derived from the PC sound card via pins 1, 8 and 9 of the connector.

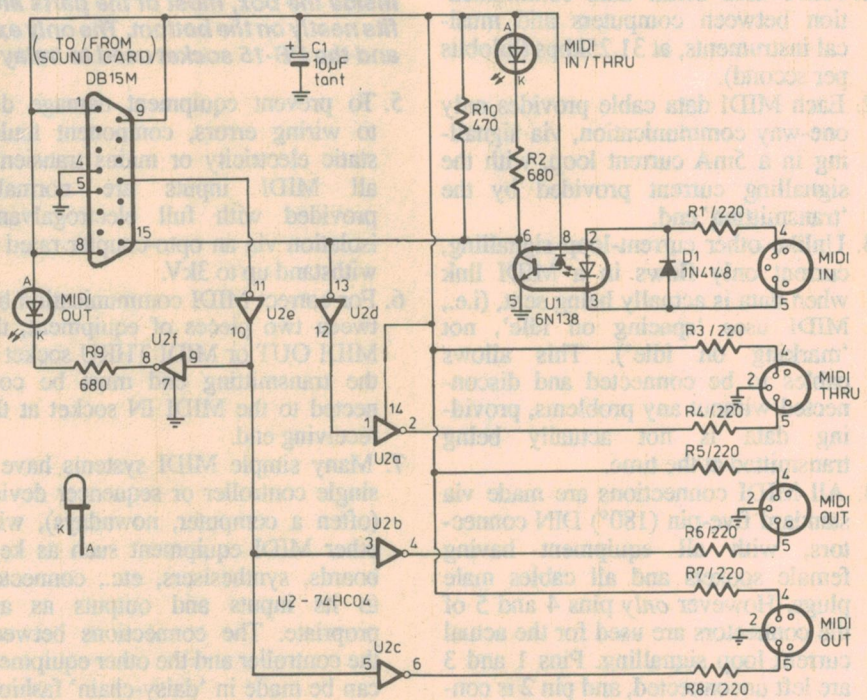
When there is no current flowing in the incoming MIDI loop, the opto-coupler's phototransistor will be off and pin 15 of the connector will thus be pulled to +5V. However when a current of 5mA flows in the MIDI loop, the phototransistor conducts and pulls the potential of pin 15 down to ground, converting the current change into a logic voltage swing.

At the same time, the MIDI IN/THRU LED will glow. (As each MIDI data bit only lasts for 32us, the glow is quite short, but with a reasonable amount of MIDI activity the LED flickers quite noticeably.)

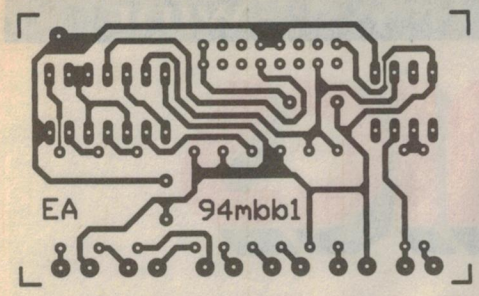
By the way, don't be tempted to substitute a different opto-coupler for U1. The 6N138 is faster in response than many others, and is the one usually specified for MIDI. Other couplers may not be fast enough, and give unreliable operation.

To produce the MIDI THRU signal, the voltage-level signal at pin 6 of U1 is also fed to inverter U2d, and this in turn feeds U2a. As a result the pair of inverters act as a buffer, which mirrors the incoming voltage swing at pin 2 of U2a. By connecting pins 4 and 5 of the MIDI THRU socket between this point and the +5V rail, via series resistors R3 and R4, we therefore turn U2a into a 5mA current driver whose output is a close replica of the MIDI IN signal.

The MIDI OUT signals are provided in a very similar fashion. Inverter U2e takes the voltage-level signal at pin 12 of the PC sound card connector (from the UART serial output), and in turn feeds inverters U2b and U2c. These each drive one of the MIDI OUT sockets via



As you can see from the schematic, the breakout box uses only two ICs and a handful of support components. It should cost you less than $45.



Here is the pattern for the PC board, as usual reproduced here actual size for those who wish to etch their own board.

series resistors R5/R6 and R7/R8, in exactly the same way as before. The sixth inverter U2f is used to drive the MIDI OUT LED, via resistor R9. As the input of U2f is connected to the output of U2e, along with those of U2b and U2c, the LED therefore glows whenever current is being sent to the MIDI OUT sockets.

That's about it. Capacitor C1 provides filtering for the +5V line and reservoir, to prevent generation of spurious signals on the MIDI lines caused by 'glitches' coming from inside the PC.

Construction

As you can see from the photographs, everything fits inside one of the standard 'UB3' jiffy boxes, measuring only 130 x 68 x 41mm. This connects to the PC sound card port connector via a 1m length of 15-way ribbon cable, ending in a DB-15M plug.

Inside the box, most of the parts are mounted on a PC board measuring only 60 x 36mm and coded 94mbb1. The only exceptions are the four DIN sockets and the two LEDs, which mount on the front panel of the box, and the 15-pin 'relay' socket for the joystick, which mounts on the end of the case. A row of PCB terminal pins along the bottom of the PCB are used to make the main connections to the DIN sockets and LEDs, while a further pin in the top right-hand corner of the PCB is used for the 'earth' connection to pin 2 of the MIDI OUT and THRU sockets.

The location and orientation of all of the parts on the PCB are shown in the PCB overlay diagram and in the closeup photo. In wiring up the PCB I suggest you fit the PCB pins, link and 16-way header strip first; then the resistors, diode and tantalum cap; and finally the opto-coupler and IC. As usual take care with the orientation of the polarised parts: diode D1, tantalum cap C1, opto-coupler U1 and IC U2.

To simplify construction, the connections to the 15-way ribbon cable are made via 'insulation displacement' (IDC) or 'crimp on' connectors. Both DB-15 connectors are crimped to the cable, with one at each end, while a 16-way DIL connector is crimped on about 80mm from the socket end, for the PCB connections. This mates with an 8x2 pin header on the PCB (J1).

The main thing to watch, when you're attaching the IDC connectors to the ribbon cable, is that you fit the two 15-way connectors the same way around (so you're not reversing the connections), and that you fit the 16-way DIL header not only the same way around, but so that the cable is over its pins 1 - 15 (i.e., with pin 16 not used).

The four DIN sockets are attached to the lid of the jiffy box using 3mm x 10mm machine screws, with nuts and star washers. The two LEDs are simply pushed into snug 5mm holes in the lid, and secured with silicone glue. Short lengths of 'rainbow' ribbon cable, about 100mm long, are then used to make the connections between these parts and the PCB terminal pins.

By the way, a shallow groove must be filed in the case end and lid, to clear the ribbon cable.

The DB-15 'joystick relay' socket fits on the end of the box, as you can see. Again it's attached via 3mm x 10mm machine screws, nuts and star washers — although here the screws are of the countersink-head type to allow a plug to be fully mated with the socket.

That's really all there is to it. The artwork for both the PCB pattern and the box label are reproduced here actual size, for those who want to duplicate them for their own unit.

PARTS LIST

Resistors

All 1/4W 5%:

7 220 ohms
2 680 ohms
1 470 ohms

Capacitors

1 10uF 16VW tantalum

Semiconductors

1 1N4148 or similar diode
2 5mm red LED
1 6N138 fast opto-coupler
1 74HC04 hex CMOS inverter

Miscellaneous

1 Jiffy box, 130 x 68 x 41mm
1 PC board, 60 x 36mm, code 94mbb1
4 Five-pin DIN sockets, 180° panel mtg.
1 DB-15 plug, IDC type
1 DB-15 socket, IDC type
1 16-way DIL connector, IDC type
1 16-way DIL header (0.1" spacing)
1 1M length 15-way ribbon cable

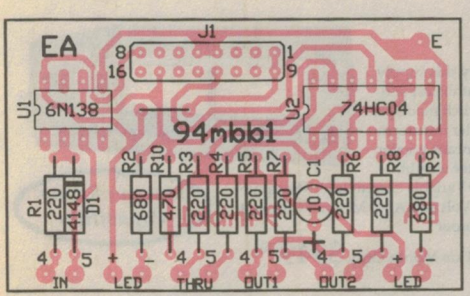
Hookup wire, 8 x round head machine screws 3mm x 10mm, two countersink-head machine screws 3mm x 10mm, 10 x 3mm nuts, 10 x 3mm star washers, 13 x PCB terminal pins, solder, etc.

Using it

Once you've completed its construction, using the MIDI breakout box is simply a matter of plugging the DB-15 plug into the PC sound card's MIDI/joystick socket, and plugging the MIDI cables from your instruments, or synthesiser, etc., into the appropriate sockets on the box. Your PC music software and MIDI equipment should now be able to talk and listen to each other, with the two LEDs flickering reassuringly as they do.

If the box doesn't work as it should, the most likely cause is that you've made a mistake with your wiring. In particular, check the 15-way ribbon cable connections carefully, in case you've managed to fit one of the IDC connectors wrongly and jumbled the connections. The connections between the PCB and the front panel parts should also be checked, along with the orientation of the polarised parts on the PCB itself.

Otherwise, you should now be ready to enjoy many hours of satisfying MIDI music making! ❖



And finally, here is the PCB overlay diagram to guide you in wiring it up. The row of terminal pins along the bottom are used to connect to the DIN sockets and LEDs, with the connections as marked. The pin marked E in the top right hand corner is used to connect to pin-2 of the MIDI THRU and MIDI OUT sockets.

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ALTRONICS

1994 ELECTRONIC COMPONENTS CATALOGUE

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Regards
Jack O'Donnell
Managing Director

Jack O'Donnell

DC-DC Converter for Car Amplifiers Kit

Most amplifier modules requires a much higher voltage than just 12 volts to operate in a car. Enter this kit. This kits input is 12 volts but its output is ±35V to 50V at 1.15 amps. This can be used to run 2 x 50W modules or 1 x 100W module. Great for building sub woofers etc.

Fantastic for our Amp Module Kits!

K 4100 Normally $139.95,
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Digital Altimeter Kit

This compact digital altimeter can display altitude up to 19,990 feet with 10 feet resolution. Accurate to better than 3.5 percent. A must for hang-gliders, ultralights etc. Operates from a single 9V battery. ***Accurate to Better than 3.5%. A must for Hang-Gliders Ultralights etc.***

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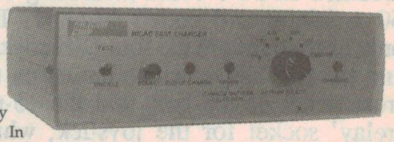
High Capacity Fast Charger for Nicad Batteries Kit



(SC Jan '91). This charger is designed to operate from a 12V battery. It can charge 6-12V nicad battery packs at up to 6A, or you can custom wire the unit to charge battery packs up to 30V at a reduced current. In operation the circuit will recharge a typical nicad racing pack in about 20 minutes. **Features:** • Fast charge rate • Switch selectable voltage setting in 1.2V steps from 6-12V • Fully punched and screened front panel • State of the art digital circuitry

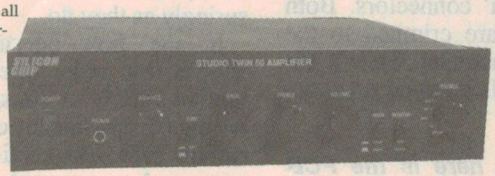
K 1660 Normally $129.00,
This Month Only $99.00

Video Fader Kit

Have you ever edited a home video before and not been satisfied with the cuts. This project uses readily available components and allows you to either smoothly fade to black as well as doing wipes left to right and vise versa for special effects. Great project for every home video buff.

K 5870 $32.95

Compact Stereo 50 + 50W Amplifier Kit



This fantastic amp has all the features of commercial units costing hundreds of dollars more. Using TIP 142/147 transistors it is capable of producing a total of 47 Watts per channel RMS into 8 ohms. Features 6 inputs, bass, treble and balance controls, headphone jack, tone defeat switch etc etc. Incorporates polyswitch protection.

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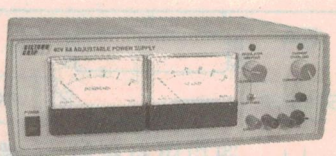
Adjustable 0-45V, 8 Amp Bench Power Supply Kit



(SC Jan-Feb '92)
Using state of the art circuitry this supply will be a great asset to the enthusiast and professional alike. It uses switch mode principles which allows for smaller transformers, and heatsinking which means greater efficiency, less heat and lighter weight.

Features: •Variable output •Variable current limit •Separate Earth Terminal •Individual Volt and Amp Meters •Constant 13.8V setting •Short circuit proof

Massive 8 Amp Capability!

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with MAJOR AL YOUNGER (USAR, Ret.)

More answers to reader questions...

It's time for me to respond to reader letters again, because I seem to have a whole desk full of them — many with really good questions. Keep those letters coming, though — they show me what subjects people need more information on. When I get many letters about one particular subject, I know I need to write an article about it.

Letters from readers are valuable feedback for me, then, and they can also be helpful for you — provided that you give me enough information on the problems concerned, so I can get enough clues to tell what's wrong.

OK then, let's look at the current crop of reader problems.

Hesitation, then bang!

Reader 'Jed', from Ourimbah in NSW, writes that he wanted to get a 1989 Toyota Camry with a V6 engine, but there weren't any in stock at the time. So he purchased the Camry with a 'four-banger'. The problem, as we understand it, is that "when it's brought to a rapid halt and then the throttle is rapidly opened again, there is hesitation and then it backfires." The O_2 sensor was changed, but he still has the same problem...

Major Al: I assume that the engine basics are correct — i.e., timing, vacuum, fuel and air filters clean, fuel pressure and battery volts OK, etc. In which case, it's an example of what I call the 'Hesitation & Bang Syndrome'.

This is a classic example of the ECM trying to compensate for a *mechanical* problem, or in other words a subsystem *that is not under ECM control*. It sounds like the EGR (exhaust gas recirculation) valve is not closing — which to the engine represents a massive air leak. Too much air equals a lean engine, which will stall, hesitate and backfire.

On a slow stop the EGR slowly closes. The ECM can control the AFR under this condition, until the *idle circuit* takes control of idle.

On this vehicle the EGR system is not controlled by the ECM (see Fig.1). But it must work correctly, or it will certainly effect the *operation* of the ECM.

So, why was the oxygen sensor changed? Well, the person who did it probably used a scanner on the ECM and got a code 25, meaning 'oxygen sensor too lean or open circuited'. This is a common mistake. (NOTE: My article in the *EA* January issue described a low cost O_2 sensor tester, to build yourself.)

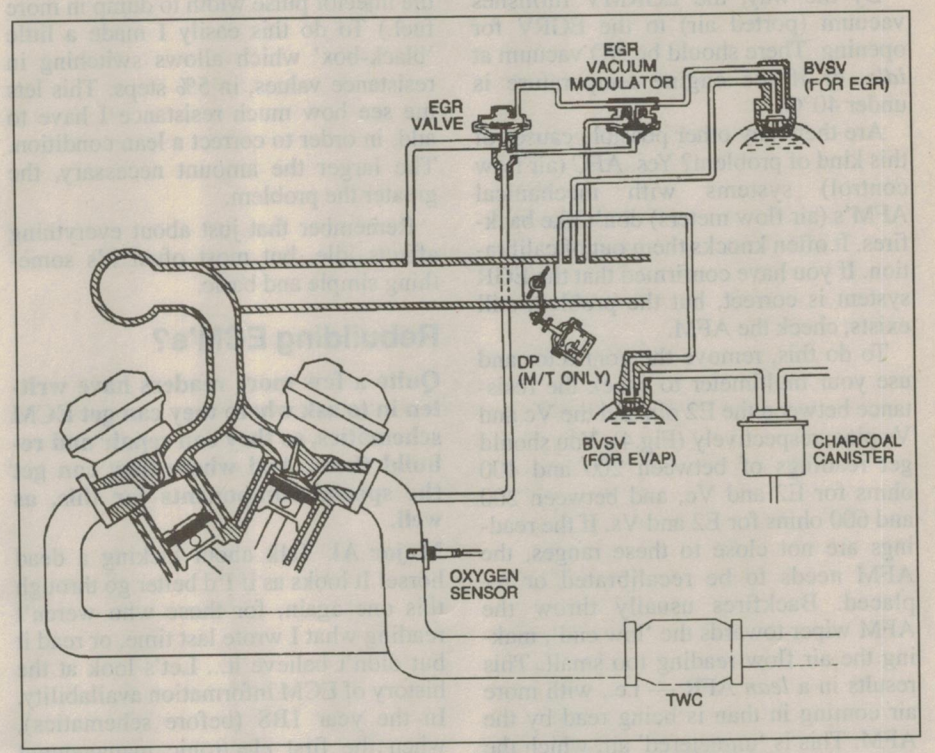


Fig.1: Toyota's vacuum-driven exhaust gas recirculation (EGR) system.

The real solution here is to find out if the EGR's malfunctioning. I will assume you have no equipment (vacuum hand pump and gauge) to check. So, temporarily disconnect and plug up the vacuum line from the EGR vacuum modulator (EGRVM) to the EGR valve (EGRV). Then heat the engine to operating temperature and test drive. If the problem's still there, the EGR valve is stuck open.

Most autotechs don't bother with that test. If they suspect the EGRV, they remove it and check it out. But *they* have the means to replace the gasket, if it's damaged by the removal of the EGRV.

If the EGRV *is* stuck open, remove it when it's cold, and see if you can blow through the valve. Mechanically open the valve; if it does not open smoothly, replace. If the seat is full of muck, scrap it off and blow again. If it still leaks, pitch it out.

If the EGRV is *not* stuck open, there's a problem in the EGR control system. Check the filter inside the EGRVM (Fig.2), and while you're at it also check the dash pot (DP, Fig.1; also Fig.3). Then check that the BVSV (bi-metal vacuum switch valve) opens at 40°C.

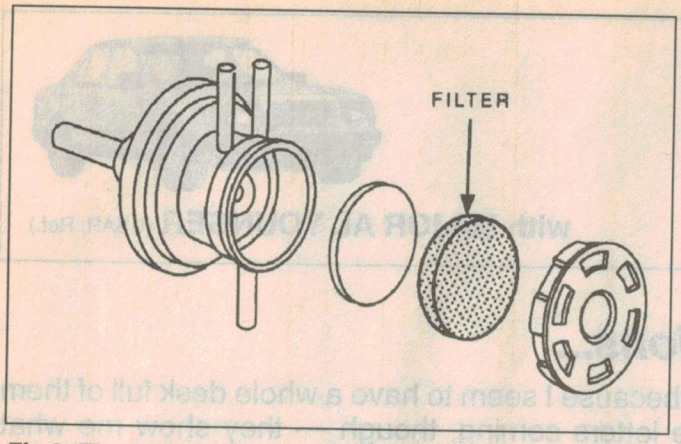


Fig.2: The EGR vacuum modulator contains a filter, which can cause problems if it gets gummed up...

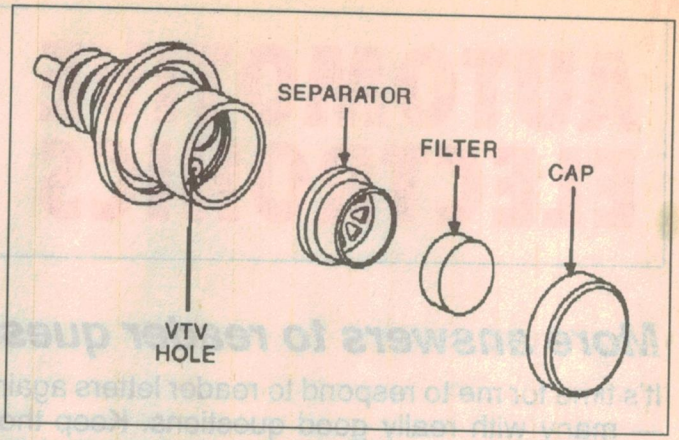


Fig.3: The dash pot (DP in Fig.1) also contains a filter, which should be checked as well.

By the way, the EGRMV furnishes vacuum (ported air) to the EGRV for opening. There should be NO vacuum at *idle*, or if the engine temperature is under 40°C.

Are there any other possible causes of this kind of problem? Yes. AFC (air flow control) systems with mechanical AFM's (air flow meters) don't like backfires. It often knocks them out of calibration. If you have confirmed that the EGR system is correct, but the problem still exists, check the AFM.

To do this, remove the connector and use your multimeter to check the resistance between the E2 pin and the Vc and Vs pins, respectively (Fig.4). You should get readings of between 200 and 400 ohms for E2 and Vc, and between 200 and 600 ohms for E2 and Vs. If the readings are not close to these ranges, the AFM needs to be recalibrated or replaced. Backfires usually throw the AFM wiper towards the 'low end', making the air flow reading too small. This results in a *lean* AFR — i.e., with more air coming in than is being read by the AFM. This is 'unmetered' air, which the ECM does not know about and therefore cannot correct for.

A quick test for a lean condition is to add a little resistance in series with the coolant temperature sensor circuit. (To the ECM, the greater the resistance the colder the engine, so the ECM increases the injector pulse width to dump in more fuel.) To do this easily I made a little 'black-box' which allows switching in resistance values, in 5% steps. This lets me see how much resistance I have to add, in order to correct a lean condition. The larger the amount necessary, the greater the problem.

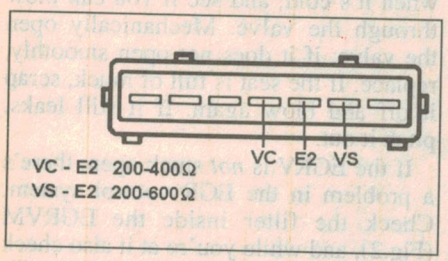


Fig.4: The connections to the Toyota air flow meter (AFM), with the resistance values to be expected.

Remember that just about everything affects idle, but most often it's something simple and basic.

Rebuilding ECM's?

Quite a few more readers have written in to ask where they can get ECM schematics, so they can repair and rebuild them. And where they can get the special components for this, as well.

Major Al: Talk about kicking a dead horse! It looks as if I'd better go through this one again, for those who weren't reading what I wrote last time, or read it but didn't believe it... Let's look at the history of ECM information availability. In the year 1BS (before schematics), when the first electronic management systems hit the road, the repair industry did not even have connector pin-outs. Of course the dealers got them first (some took nine months), but the aftermarket books took a year.

In the meantime, many shops were tracing sensor wires from the engine compartment back to the ECM, using wire colour codes. Many times we would have to cut the whole harness open, because the manufacturer did not follow their own colour codes. And so it went —finding things out the hard way.

We then went through the problem of not knowing what the voltages should be. For years, books stated sensor voltages as '0 - 5 volts'. Of course that's not very helpful — just giving the total range possible. What you need, to make any sense of things, is to know how the sensor's voltage varies with whatever it is that it's sensing...

Those of us with an electronic background were happy just to have the pin-outs. This saved us a lot of time, which we needed to figure out or measure the voltages. It doesn't take too long to work things out, when about 30 shops help each other out. I was a member of such a little group in North America, which was actually the first to work out all the voltages for all vehicles made in North America. We then started 'collecting' (measuring) voltages on imported cars...

In the meantime, I spent (wasted) much time on long distance telephone calls to Detroit, in search of schematics for ECM's. Now, I personally know people high up at GM, Ford and Chrysler, and I found the hard way that if the vice president (International) of Chrysler cannot help you, give up. He sent me about 50 kilo's of manuals — but no schematics, and nothing on the ECM's internal workings.

Why? Simple! The car makers themselves don't make them. They are made to their specifications; if they don't work, they simply send them back. To them an ECM is just another component.

If you try contacting the ECM manufacturer, he tells you the units are proprietary, and sends you back to the auto maker. You have just done a complete circle, and got nowhere...

So you open up an ECM and see an Intel chip. You call Intel, and give them the chip number. They'll tell you that the number is not for one of their standard chips. *That* number is assigned to the company we manufactured the chip for. So now you call the car maker's spare parts department, and give them the number. But the unit (ECM) that the part came from, is not 'serviceable' — meaning we're not supposed to fix them, just replace them; so that number means nothing to them.

Sorry to disappoint you, but this is the way it is. The car manufacturers can't supply you with an ECM schematic because they don't have them, and they don't have them because they don't need them. So don't waste effort by asking.

If you want to start a business fixing ECM's, that's great. First off, build yourself a tester. It's easy: pick up an ECM, a wiring harness, all the sensors and actuators and start testing. After all, 75% of all ECM's diagnosed as bad, are actually OK. Start collecting ECM's for spare parts.

But the best guidance I can give you on collecting information on ECM operation is: *open the bloody bonnet and measure it, because this is basically the only way you'll get it.*

Please — no more letters asking for ECM schematics, or where you can source parts to fix them. You're asking the impossible.

Hotting up PROMs...

Another group of readers have written to ask what is involved in reprogramming their ECM, so they can increase engine performance. Isn't it simply a matter of being able to read and write programs in PROM?

Major Al: It takes a lot more than that, and it's becoming more difficult every day. Some manufacturers make entry very difficult and this is understandable — Detroit doesn't want people rewriting *their* chips. That's another reason why they won't provide information on ECM operation. In fact, you'll find that adding an after-market chip generally voids both your *factory* and *extended* warranties.

Yes, rewriting chips is becoming big business. But if you think one of the companies doing this is going to share their information with you, then you must believe in the 'tooth fairy'. It's what I call a closed shop, as far as information goes.

Is a 'hotted up chip' worth it? In my experience, yes. Some of the after-market 'off the shelf' chips do wonders. But the best approach, of course, is a custom chip made for your car.

If this is the way you want to go, there's two available options. Some custom-chip makers provide several programs (modes) for you to try, which are switchable. Other companies put your car on a chassis dynamometer, determine the torque curve, and 'cut you a custom chip'.

I prefer the latter method, with switchable mode functions like: Economy, Normal and Performance. Sound familiar? Sure does — it's already available in some production cars.

If you want an EFI system which lets you can write your own program easily, they're readily available. Such products or companies as: Autronic, Motec, Link-EMX, Microtech, Haltech and Injec.

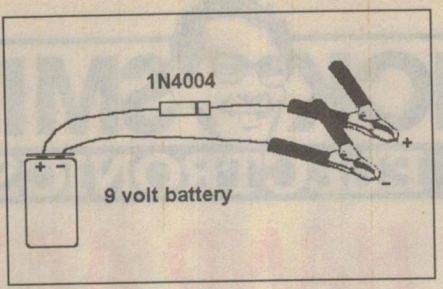


Fig.5: A simple build-it-yourself 'memory saver' for ECMs.

Lost its memory

Reader G.J. removed his car battery to jump-start an outboard motor with a flat battery. Upon re-installing the battery and starting the car, the engine ran rough and at a higher idle speed. "It ran fine down the road, just had a bad idle in town. But before I panicked and took the car for a service, the problem went away. Would this be the 'Block Learn' process you talked about in your articles?"

Major Al: You got it, mate — good on yah! Your ECM lost all its data in KAM (keep alive memory), when you removed the battery voltage. This includes driver's habits and most important, idle data. So the system had to 'relearn' it all over again, and 'acted up' while this was happening.

A low cost 'memory saver' would have saved you all the anxiety. What's a memory saver? See Fig.5. As you can see, it's nothing more than a standard nine volt battery and 'snap lead', wired in series with a protective diode and fitted with a pair of small battery clips. Any power diode will do, like the 1N4004 — which costs about 15 cents at your local electronics store.

To use this simple gizmo, turn off all of the car's accessories and lamps, so there's no unnecessary current drain. Then attach the memory saver's clips to the battery cables (positive to positive, negative to negative), before you undo the main battery connectors, to remove it. Although it looks so tiny, the 9V battery provides enough energy to prevent the ECM from losing its memory, while the main battery is away.

Make up a little unit like this in a plastic 'jiffy' box, and keep it in your boot with your jumper cables. Commercial units are available, which push into the cigarette lighter socket.

Memory savers are worth having. As well as stopping your ECM from getting amnesia, you won't have to reset your digital clock or reprogram your radio tuning, every time the battery connections are broken.

Booklet questions

A few readers have written in with questions about Major Al's own booklets. A common question is whether his booklet *Maintaining the Electronic Motor Car* contains information on servicing the electronics in a vehicle.

Major Al: No, it's not on electronics, since there's nothing to 'tweak' under the bonnet. It simply provides information additional to that provided by the car owner's manual. It also has a list of leaded cars that can run on unleaded petrol. It sells for $25.00.

The *Code Book* contains ECM diagnostic code and retrieval data on all vehicles manufactured in Australia and the popular imports. It sells for $35.00.

The *Ford EEC-IV* booklet (63 pages) and the *GM C-3* booklet (43 pages) provide system information to allow the autotech to fix cars with these systems. They are written from an autotech's viewpoint, on what one should know to fix the car. They contain pin-outs, codes, fixes, location drawings, voltages and schematics, and they sell for $60.00 each. (A lot of hard work went into getting this information together.)

If you want any of these booklets, send a cheque with your order to Al Younger, PO Box 477, Double Bay, NSW 2028. ❖

NEW KITS FOR EA PROJECTS

We have received the following information from Dick Smith Electronics regarding their release of kits for recent *Electronics Australia* construction projects:

Versatile 40V/3A Lab Power Supply (December 1993/January 1994): The DSE kit is complete with case, punched and silk-screened front panel and punched rear panel, PCB, transformer, heatsinks and all specified electronic components. It carries the catalog number K 3206 and is priced at $169.00.

DDS on a PC (January 1994): The DSE kit is of the 'short form' type, and includes the PCB and all components for the interface, plus a disk with the software. Carrying the catalog number K 7344, the kit is priced at $22.95.

NOTE: This information is published in good faith, from information supplied by the firm or firms concerned and as a service to readers. Electronics Australia cannot accept responsibility for errors or omissions.

DICK SMITH ELECTRONICS

TRY YOUR HAND AT THESE KITS!

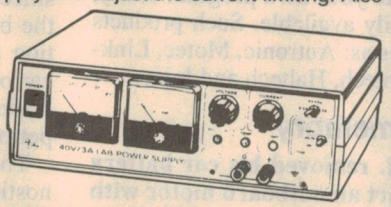
Get All Your Power From One Supply!

40V/3A Power Supply

INCLUDING MYSTERY BONUS!

A strong power supply for your benchtop!
While this power supply is of relatively simple construction, it provides an output voltage of 0 to 40V (0+/-20V), output current of up to 3.5A and current limit of approx. 30mA to 3.5A in two ranges and features meters for both voltage and current readings. It offers full electrical and thermal overload protection and, unlike most power supplies, lets you choose between single or dual-tracking supply and adjust the current limiting. Also includes output load switching, current setting switch and a dropout indicator. Complete with all components, hardware, PCB, case and pre-punched screened front panel.

K-3206



$169

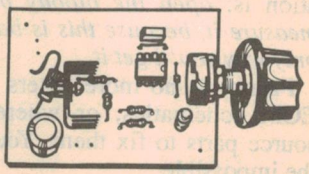
EA Jan '94

Easy To Build!

DC Motor Controller

Using just one 555 timer IC, this simple kit can control 12V DC mini drill motors or lights with currents up to 1 amp. It contains just a few components and employs the pulse-width modulation (PWM) technique to send bursts of current to the motor, providing an efficient means of varying motor speed. Comes in shortform, with all components, PCB and mini heatsink for the switching transistor.

K-3070



$10.95

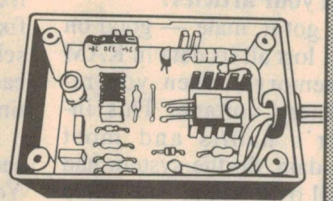
Silicon Chip Jan '94

Sick Of Getting A Flat Battery?

Car Light Switch-Off Timer

There's nothing worse than returning to your car to discover that the battery is flat. This scenario is often caused by leaving your car's internal light on, either by not shutting the door properly or by simply forgetting to turn it off. That dreaded feeling will be a thing of the past once you build this kit! By connecting it with the positive supply to the interior light circuit, the light switch-off timer can control the power to the lamps and automatically turn them off after approximately two minutes. The kit comes complete with plastic case, hardware, PCB and all components.

Cat K-4212



$16.95

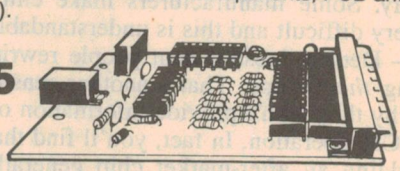
Silicon Chip Oct '93

DDS On Your PC!

Direct Digital Synthesiser

This kit is great for experimenting with or demonstrating the principles of direct digital synthesis (DDS). Using software on your PC, it's both inexpensive and easy. It simply connects to your PC's printer port and generates precision frequencies in the audio range (from 1Hz to approximately 12kHz - depending on the speed of your PC). Its output can be either sine, square, sawtooth, triangle or virtually any repetitive waveform. Comes in shortform with all components, PCB and software (3.5" disk).

Cat K-7344



$22.95

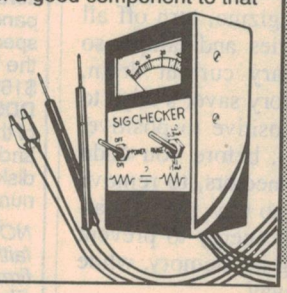
EA Jan '94

Signal Checker

Simplest Signature Analyser Yet!

Now you can build your own simple, cost-effective signal checker! Without being as complex as traditional models, this compact version can compare circuits point by point. If you have a faulty board and a good board for comparison, you can easily find the bad components that are out of spec and repair the board. The Signal Checker integrates the magnitude of the difference between the signature of a good component to that of a bad one and displays it on a meter reading. Operated by one 9V battery (not included), it comes in full form, with all components, hardware bits, panel meter, PCB, zippy box, pre-punched silk-screened front panel and test probes.

Cat K-7226



$39.95

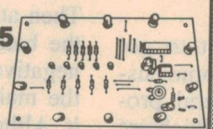
EA Aug '93

Simple LED Chaser

NEW

Perfect for newcomers to electronics, this is a simple project with an eye-catching result. Using just two IC's, it flashes 10 LEDs around in a clockwise direction. You'll learn about counters and oscillators while you build and the finished result makes an attention-grabbing display. Comes in short-form with components and PCB only.

Cat K-3166



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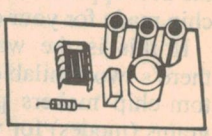

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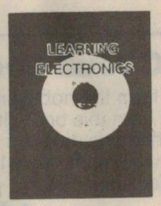

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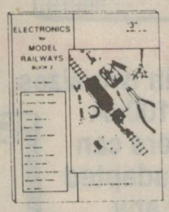

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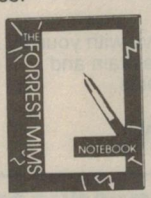

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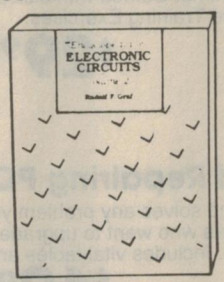

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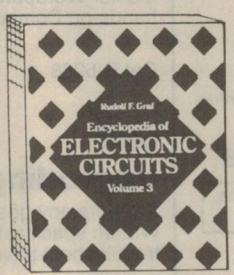

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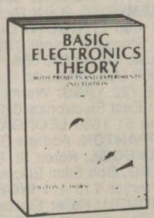

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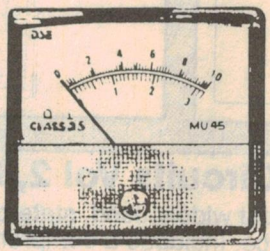

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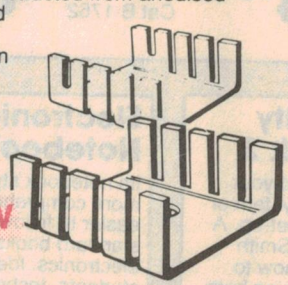

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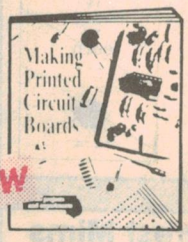

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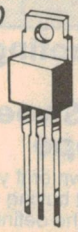

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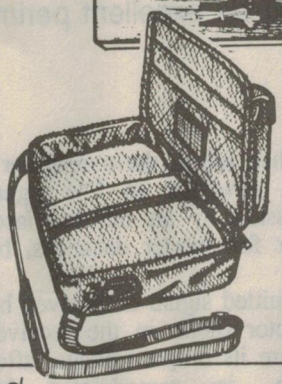

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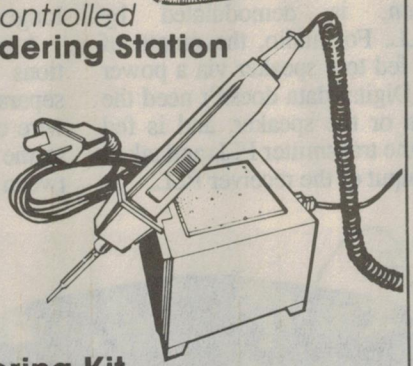

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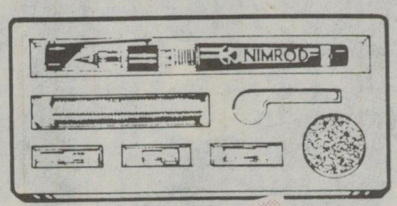

This butane-powered, temperature-controlled (400-1300°C) soldering iron comes with many accessories including: Stand, solder (with dispenser), tip cleaner, hot air tip, torch tip and hot knife tip. It's ideal for outdoor work (no power-point required) and it packs neatly into its own cushioned case.
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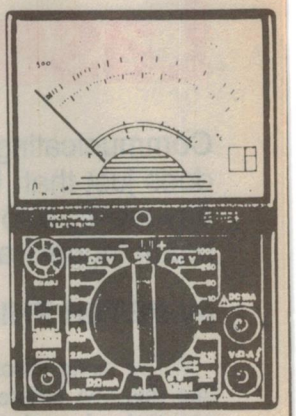

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B 1653

Construction Project:

Laser Beam Communicator

Communicating over a laser beam has an almost fictional quality to it, but this inexpensive project does just that. It can handle high quality audio or digital data and the link is virtually impossible for anyone else to tap into. The project is also an excellent perimeter protector, where breaking the beam triggers a relay.

by PETER PHILLIPS

We've never described a project quite like this one before, mainly because it uses technology that's only now becoming affordable to individuals. Designed by Oatley Electronics, the 'link' as I'll call it, is intentionally cheap (see end of article) yet sophisticated in all respects.

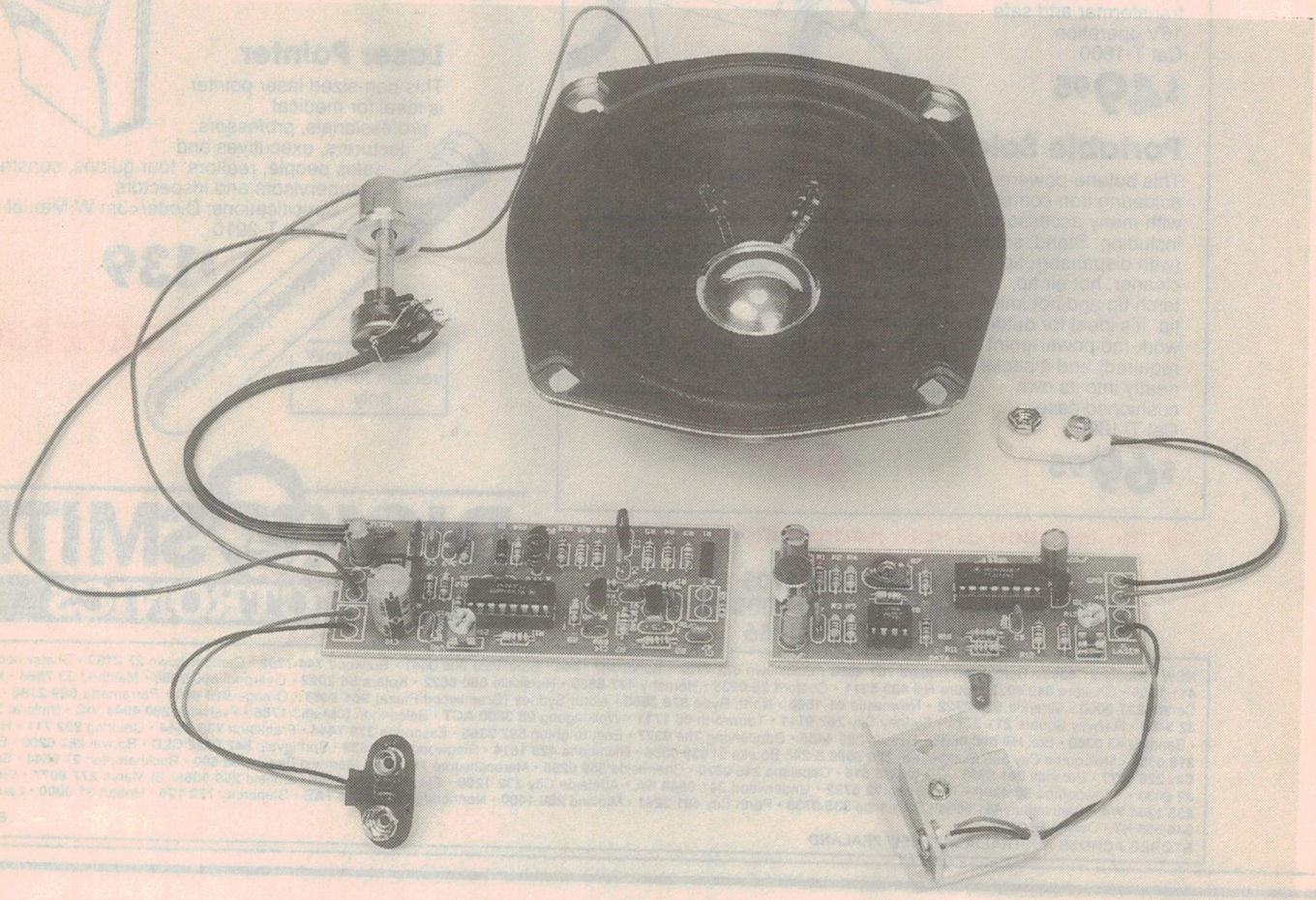
Basically the link consists of a transmitter and a receiver based around individual 4046 phase-locked loop (PLL) ICs, operating at about 200kHz. An onboard microphone on the transmitter PCB produces the signal for conventional audio transmission.

The output of the microphone is amplified, then fed to the transmitter's PLL which develops an FM signal for transmission by an infrared laser diode — or for shorter distances, by an IR LED.

The transmitted signal is received by an IR detector diode in the receiver module where its output voltage, after amplification, is demodulated by another PLL. For audio, the output of the PLL is fed to a speaker via a power output IC. Digital data doesn't need the microphone or the speaker, and is fed directly to the transmitter PLL and taken from the output of the receiver PLL.

The transmitting medium is infrared (IR) light, which can be produced by either an IR laser diode or by IR LEDs. If line-of- sight is not possible, the modulated IR light can be sent via an optical fibre. The transmission distance with an IR laser diode link has been tested to over 300 metres, but much longer distances are possible.

A typical use would be a communications link between two buildings, separated by a roadway which makes a wire connection impossible. Or perhaps to the house next door, or as a link between the workshop and the house.



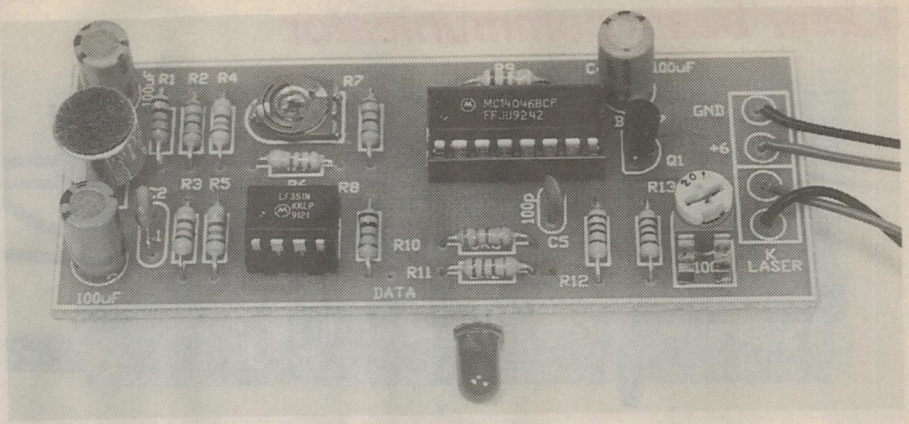
An important feature of this transmission method is privacy. Because a laser beam is intentionally narrow, it's virtually impossible for someone to tap into the data link without you knowing.

If someone intercepts the beam, the link is broken, signalling the interception. Being infrared, the beam cannot be seen without special IR viewing equipment, so it would be difficult to even locate the beam in the first place, let alone tap into it without the owner knowing.

Fibre-optic cables also have a high security, as it's very difficult to splice into the cable without breaking the link. However it's theoretically possible, so for the highest security, use a line-of-sight laser beam.

Where the transmission distance is no more than a few metres, an IR LED (or two for increased power) can be substituted for the laser diode. For instance, where the link is being used for educational purposes, such as demonstrating fibre-optic coupling or the concept of communication over a light beam. Obviously the security of the transmission is much lower as IR LEDs transmit IR light over a wide angle.

And there's another very useful application: perimeter protection. Devices that operate with either visible light or IR light are often used to detect someone passing through a door. But these are usually for short distances, such as the span of a doorway. This project can do the same thing, but because it uses a laser diode, over considerably longer distances. For example, it could protect your front yard, or all entrances that share the same line of a building, car park entries and so on. That is, any line-of-sight distance within the range of the laser diode.



This view shows the transmitter PCB. The laser diode/lens assembly (not shown here) is shown in detail in Fig.3 and Fig.4.

WARNING

Even though the IR laser diode used in this project produces an output which is barely visible, it is a class 3B laser and you should attach a warning label to the transmitter. Labels will be supplied by Oatley Electronics.

If you are concerned that someone (a child perhaps) might stare at the beam in a perimeter protection application, you could connect the receiver relay operating the alarm so it also removes power to the transmitter as soon as the beam is broken. This way a child breaking the beam to stare at the 'pretty light' is protected from possible eye injury. Power to the transmitter is then restored when the alarm reset button is pressed.

Remember that, like gun owners, the owner of a laser is responsible for its proper use.

The transmitter

The circuit of the transmitter is shown in Fig.1. The output of the microphone is amplified by IC1, which is connected as an inverting amplifier with an adjustable gain, variable from unity to over 20 with VR1. DC is supplied to the microphone by R1, which connects to the power supply via decoupling components R2 and C1.

The output of the op amp is connected through R7 to the input of the voltage controlled oscillator inside phase-lock loop IC2. Digital data is applied to the PLL via R8, and if the transmitter is only used for digital data, the microphone, IC1 and associated components can be

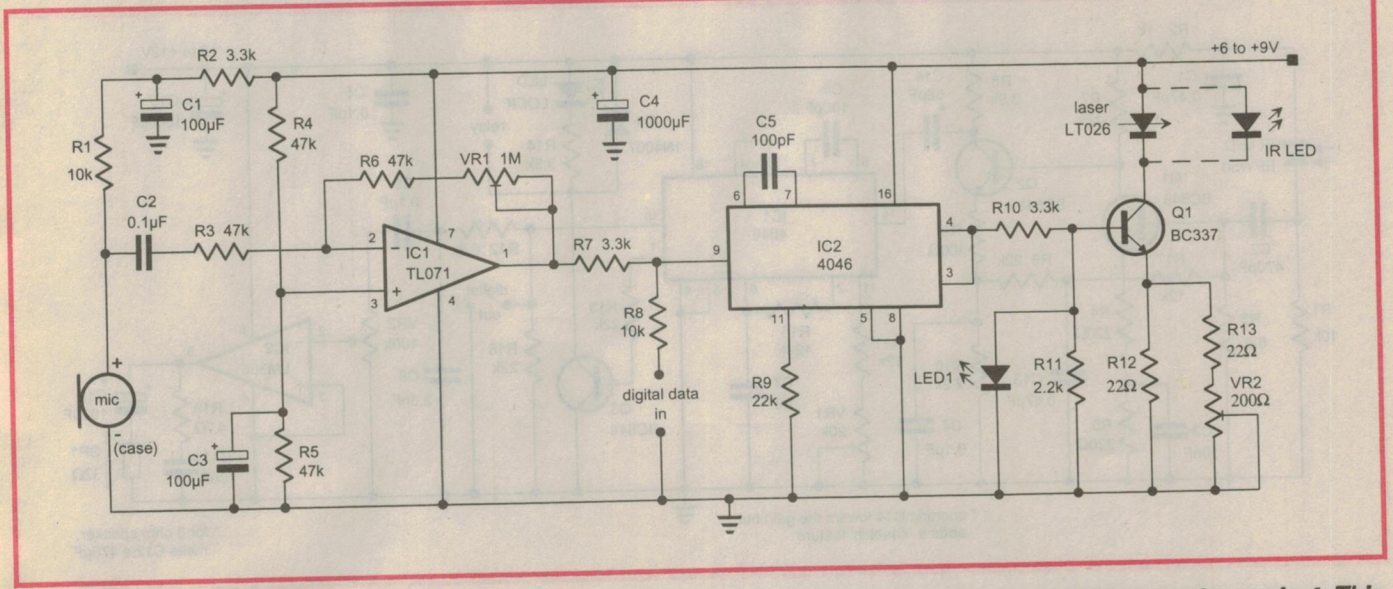
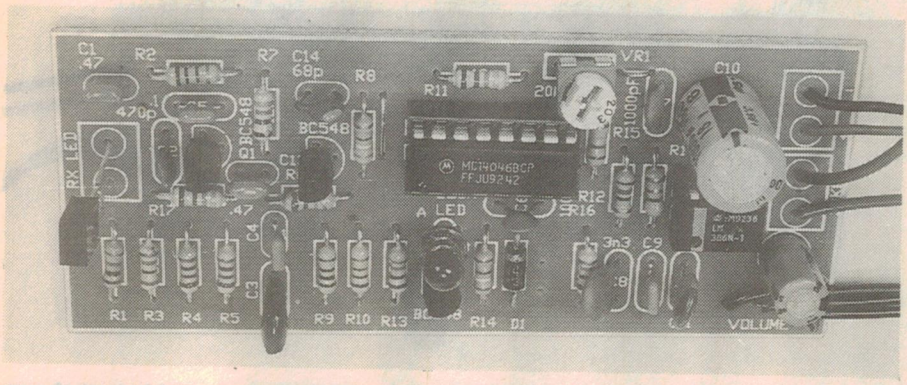


Fig.1: The transmitter is based around a 4046 PLL, which produces a frequency modulated 350kHz carrier at pin 4. This signal is transmitted by an IR laser diode or IR LED, driven by Q1. The modulating signal is from either the onboard microphone or external digital data.

Laser beam communicator



Here's a close-up of the receiver PCB in the prototype. You might want to refer to this when assembling it.

deleted. The nominal frequency of the PLL oscillator is determined by C5 and R9, which for the values shown is around 200kHz.

The output of the PLL is at pin 4, which connects back into a phase comparator inside the PLL through pin 3. The output signal is a frequency modulated 200kHz carrier, which connects through R10 to the base of Q1. This signal is essentially a square wave, with a peak to peak value of 6V or so. Transistor Q1 drives the IR laser diode (or IR LED).

The specified laser diode is a type LT026, which has a maximum forward DC current of 100mA. Exceeding this value will damage the diode, so the recommended value is 65mA. However if an IR LED is used rather than a laser diode, the recommended forward current is higher at 100mA or so. For this reason, the quiescent current is adjustable with VR2. However, it's important to stabilise this current, which is achieved by LED1. This LED holds the base voltage of Q1 at about 1.8V, clipping the signal voltage applied to the base of Q1 to this value. The voltage across R12 is therefore limited to 1.2V, and the emitter current is limited to 1.2V divided by the total resistance from the emitter terminal to ground.

Because the duty cycle of the signal averages 50%, the quiescent current through the transistor will measure half the recommended value. So for the laser diode, the current should be set to measure around 34mA; and for an IR LED to 50mA.

Educators please note:

Although billed as an IR laser link, there's nothing to stop you having a conventional LED in the transmitter and a visible light photodetector in the receiver. This would be ideal for educational purposes as you can see the light serving as the data link.

Or perhaps you want to demonstrate transmission through fibre optic cable, but you don't have the means of terminating the cable. Oatley Electronics have just secured a limited quantity of plastic 'light pipe'.

This amazing material transmits light in a similar way to fibre optic cable. However it has a 5mm diameter, which means you simply direct the light source to one end of the cable and point the other end at the detector diode.

The cost is $3 per metre, which is remarkable considering this material is usually $35/m or more...

The receiver

The transmitted signal is picked up by the IR detector diode in the receiver (shown in Fig.2). The output voltage of this diode is amplified by the high gain DC-coupled amplifier around Q1 and Q2, then connected via C14 to a phase comparator within IC1, another 4046 PLL.

Replacing C14 with a short-circuit, giving DC coupling between the amplifier and the PLL, will eliminate the 'hiss' associated with an FM receiver tuned between stations. The cost for this 'squelch' feature is reduced gain, which may not be a problem in many applications.

The frequency of the internal voltage controlled oscillator (VCO) of the receiver PLL is determined by the values of C6 and the series resistance of R11 and VR1. The purpose of VR1 is to adjust the operating frequency of the oscil-

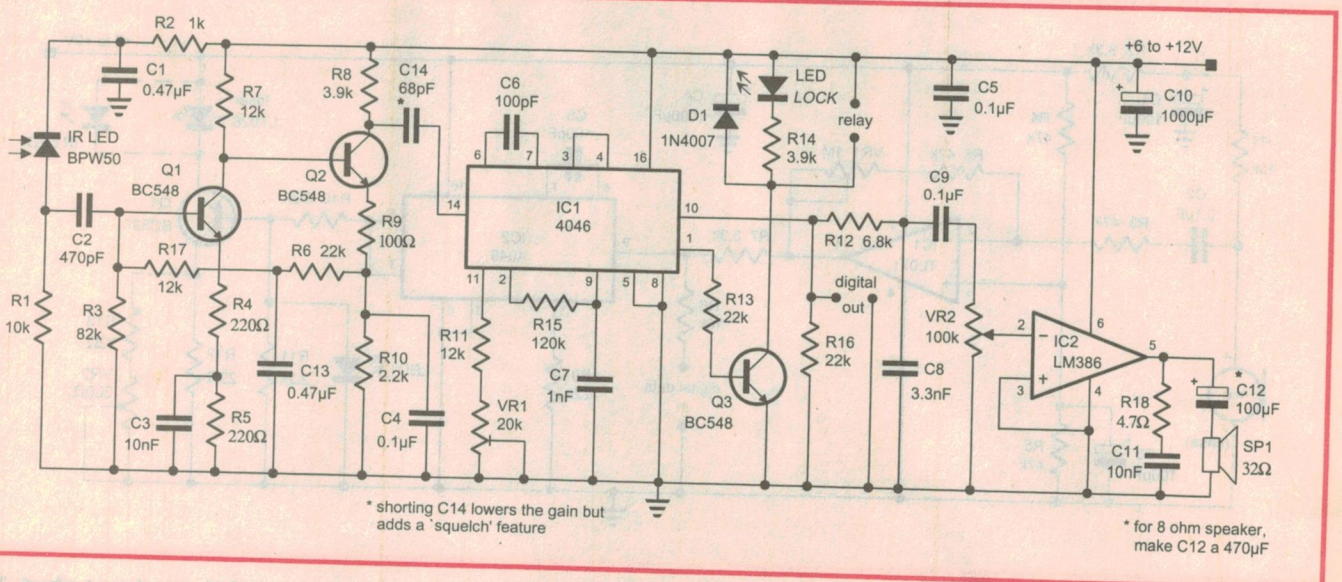


Fig.2: The circuit of the receiver, where IR light from the transmitter is detected and converted to a voltage by the IR detector diode. The signal is amplified by Q1 and Q2, then demodulated by IC1. When IC1 is locked to a transmission, the voltage at pin 1 operates Q3 and the 'lock' LED. The demodulated output is at pin 10.

PARTS LIST - Transmitter

Resistors

All 1/4W, 5% unless otherwise stated:

R1,8	10k
R2,7,10	3.3k
R3-6	47k
R9	22k
R11	2.2k
R12,13	22 ohm
VR1	1M trimpot
VR2	200 ohm trimpot

Capacitors

C1,3,4	100uF 16V electrolytic
C2	0.1uF mono
C5	100pF ceramic

Semiconductors

LED1	5mm red LED
IR source	LT026 laser diode or IR LED
Q1	BC337 NPN
IC1	TL-071 op amp
IC2	4046 PLL

Miscellaneous

PCB 34mm x 85mm coded OE/ATX/93a; electret microphone element; 16 pin IC socket; 9V battery and battery clip, suitable pieces of aluminium angle; collimating lens; self-tapping screw.

PARTS LIST - Receiver

Resistors

All 1/4W, 5% unless otherwise stated:

R1	10k
R2	1k
R3	82k
R4,5	220 ohm
R6,13,16	22k
R7,11,17	12k
R8,14	3.9k
R9	100 ohm
R10	2.2k
R12	6.8k
R15	120k
R18	4.7 ohm
VR1	20k trimpot
VR2	100k panel mount pot

Capacitors

C1,13	0.47uF mono
C2	470pF ceramic
C3	10nF polyester
C4,5,9	0.1 mono
C6	100pF ceramic
C7	1nF ceramic
C8	3.3nF ceramic
C10	1000uF 16V electrolytic
C11	10nF ceramic
C12	100uF 16V electrolytic
C14	68pF ceramic

Semiconductors

LED1	5mm red LED
IR detector	BPW50
Q1-3	BC548 NPN
IC1	4046 PLL
IC2	LM386 power op amp

Miscellaneous

PCB 40mm x 94m coded OE/ARX/93b; 9V battery and battery clip, 32 ohm speaker; 8 pin and 16 pin IC socket.

Kits of parts for these projects are available from:

Oatley Electronics
5 Lansdowne Parade,
Oatley West, NSW 2223.
Phone (02) 579 4985
Postal address (mail orders):
PO Box 89, Oatley West NSW 2223.
Both PCBs, all on-board components, detector diode, speaker and IR LED $30.
LT026 IR laser diode with collimating lens $25.00.
Two metre length of fibre optic cable $2.00
Post and pack charges $4
NOTE: This project is copyright to Oatley Electronics.

lator to give the best sensitivity. A low-pass filter, formed by R15 and C7 connects the output of the internal phase comparator to the input of the VCO.

Output pin 1 of the PLL is connected to Q3, which drives a LED or an optional relay. This pin switches high when the internal oscillator is locked to the input signal at pin 14, turning on Q3 and the LED (also the optional relay). Therefore, when the LED is on, it indicates the PLL is locked to a received signal.

The relay is used when the application is perimeter protection, where an interrupted beam causes the relay to drop out. Otherwise, the relay is held on because of the voltage at pin 1. Diode D1 limits the back EMF from the relay coil when the relay is turned off.

The demodulated output signal is taken from pin 10 of IC1, and connected via the low-pass filter of R12 and C8. It then passes through C9 to VR2, which is the receiver's volume control.

The signal is then fed to the inverting input of IC2 type LM386, which is a 350mW audio power amplifier. The speaker is connected to the output of the amplifier through C12. The value shown suits a 32 ohm speaker, but should be increased to 470uF for lower impedance speakers.

Construction

As the photos show, both the transmitter and the receiver are built on silk-screened PCBs. As usual fit the links, resistors, pots and capacitors first, taking care with the polarity of the electrolytics. IC sockets are not essential, although servicing is obviously made easier if they are used. If you elect to use sockets, fit these next, followed by the transistors and LEDs. The IR detector diode is mounted directly on the receiver PCB. The anode of the diode is marked with an indent in the case near the lead.

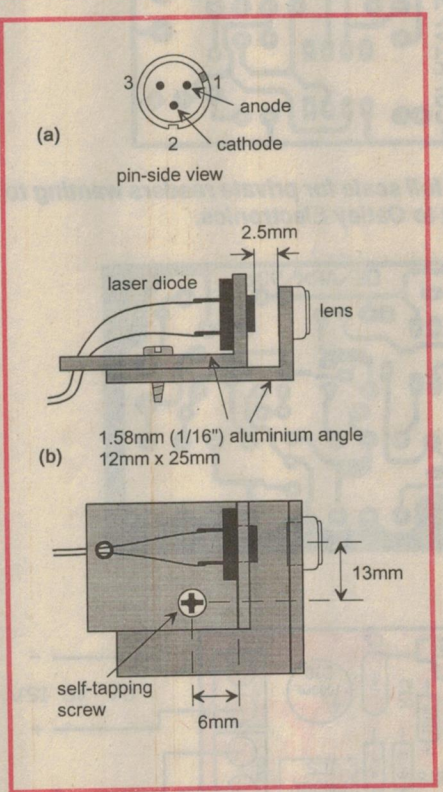


Fig.3: Diagram (a) shows the pin connections of the LT026 laser diode and (b) the details of the assembly used in the prototype to hold the laser diode and the collimating lens.

The polarised microphone element solders directly to the transmitter PCB. The negative lead is marked with a minus sign and is the lead which connects to the metal case.

The laser diode is also polarised, and has three leads. Of these, only two are used, shown on the circuit as pins 1 (anode) and 2. The pin details of the laser diode are shown in Fig.3(a). However, before connecting the laser diode, it has to be fitted to a support assembly that holds it and the collimating lens. Here's the details...

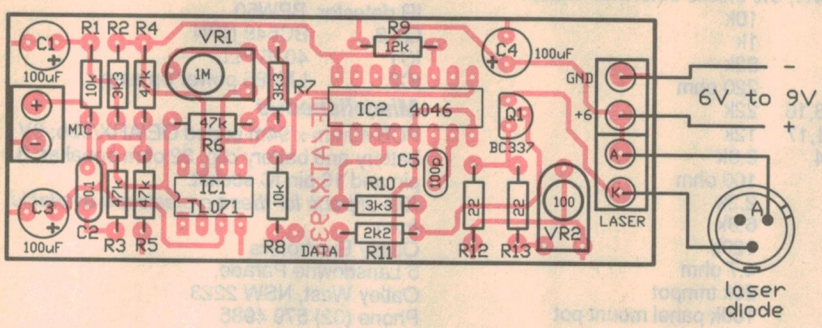
Laser assembly

The laser diode needs a collimating lens (supplied in the kit) to focus the beam to a sharp point. Without the lens, the beam spreads out, losing its intensity. The assembly used in the prototype to hold the diode and the lens is shown in Fig.3(b) and in the photo of Fig.4. It is made from two small sections of aluminium angle. The length of each piece depends on how you intend mounting the assembly, and in the prototype the bottom section was 40mm and the top 25mm.

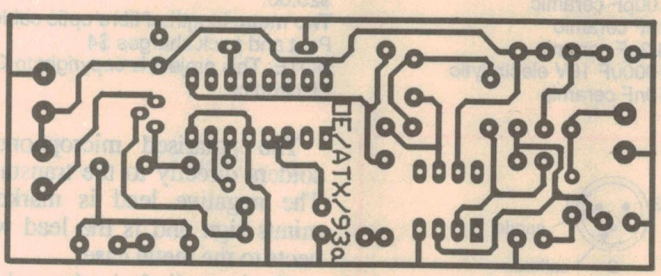
To ensure the lens and the diode are exactly aligned, clamp the two pieces of aluminium angle together, then drill a pilot hole through both pieces. The main holes are then drilled to a larger size to suit. Choose a size so the diode and the lens are a push fit.

The spacing between the front of the laser diode and the lens is critical to get the sharpest focus (and therefore the longest range). To achieve this, space the two pieces of angle to give a distance of

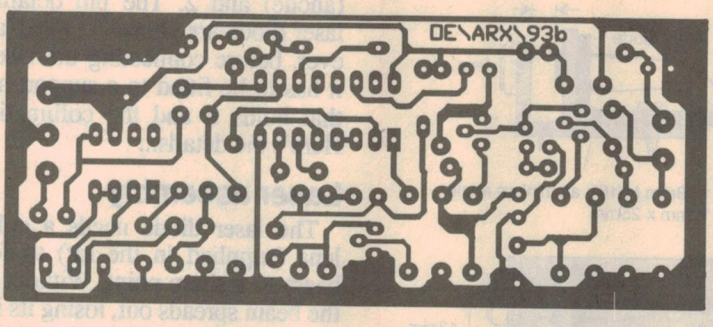
Laser beam communicator

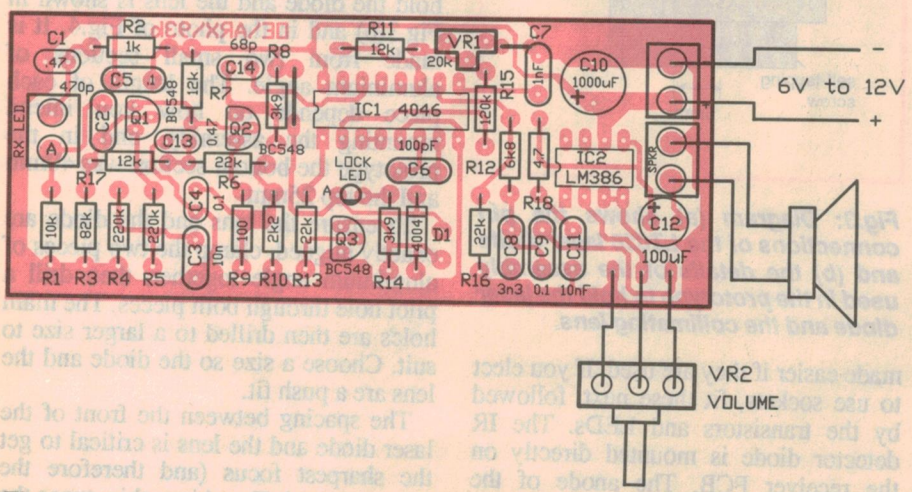


The transmitter layout. The negative lead of the microphone element is the one connected to the microphone case. Fig.3(a) gives details of the laser diode pin connections.



The artwork for both PCBs, reproduced full scale for private readers wanting to make their own. The design is copyright to Oatley Electronics.





The layout of the receiver PCB is shown here. The anode of the IR detector diode is marked with an indent in the case.

2.5mm between the front of the diode and the rear of the lens. Then drill a single hole for a self-tapping screw as shown in the diagram.

Final adjustment is then simply a matter of swinging the section holding the laser diode towards or away from the piece holding the lens. This is further explained later on.

Testing

Both the receiver and the transmitter can be powered by separate 9V batteries or suitable DC supplies. When power is applied to the transmitter PCB you should see LED1 light, indicating an output from the PLL. The LED on the receiver PCB will only light when the receiver PLL is locked to a transmission.

The first job is to set the quiescent current passing through the laser diode. This is achieved by measuring the current taken by the transmitter PCB and adjusting VR2 to give an average current consumption of around 34mA (or 50mA for an IR LED). Note that the output of the laser diode is virtually invisible, although you'll be able to just see the beam reflected from a surface in dark conditions. **As with any laser, don't look into the diode!**

To check that the system is working, place the two PCBs on the workbench, spaced a metre or so apart. Set the gain of the microphone amplifier (with VR1) to a maximum, and the volume control of the speaker to just above zero. If the volume control setting is too high, you'll get acoustic feedback.

Move the laser diode assembly so the beam points at the receiver's IR detector diode. When the two are aligned, the 'LOCK' LED on the receiver PCB will light. You should now be able to hear the speaker reproducing any audio signal picked up by the microphone.

Adjust VR1 (on the receiver PCB) to give the best clarity. This adjustment trims the free-running frequency of the receiver PLL, and also determines the sensitivity. Therefore, adjust VR1 for best gain when the received signal is relatively weak.

When the receiver and transmitter are in close range, the strength of the beam will cause the receiver to respond even if the laser beam is not falling on the detector diode.

Setting up a link

Once you've tested the link, you'll probably be keen to put it to use. Whether you use it as a perimeter guard or a data link, you'll need to position the receiver and transmitter so the laser beam strikes the IR detector diode. As

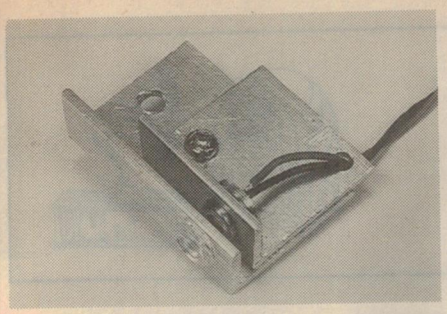


Fig.4: This photo is a close up of the laser diode, collimating lens assembly. Final focus adjustment is made by pivoting the top section to get the sharpest beam.

well, the beam needs to be accurately focused.

If you have an IR night viewer, these jobs are quite easy, as you'll be able to see the beam through the viewer. In this case, set the transmitter up so the beam is hitting a surface a few metres away. Focus the beam by pivoting the bracket holding the laser diode away or towards the lens. Once the pinpoint of light (as seen through the viewer) is as small as you can get it, lock the angle brackets in place. The movement to get the right focus will be quite small...

An IR viewer will also help considerably when it comes to aligning the beam so it strikes the IR diode in the receiver. However, it's possible to see the laser beam under dark conditions, if you know where to look. The pinpoint of light striking a surface will be just visible, letting you focus and align it. Naturally, the longer the distance, the fainter the beam.

Another way is to observe the waveform at pin 14 of the PLL on the receiver with a 'scope. The idea is to peak the amplitude of this waveform by appropriate adjustment and alignment of the laser beam. Of course, adjustment by trial and error will also work, once you've got the laser beam roughly focused onto the IR LED.

Because of the high output power (5mW) of the laser diode, excellent results will be obtained over reasonably short distances (20 metres or so) with rough adjustments. The longer the distance between the transmitter and the receiver, the more critical the adjustment.

The IR detector diode in the receiver has a response which peaks at a wavelength of 940nm. The laser diode produces IR light with a wavelength of 780nm, giving an output from the IR LED about 10% that of a light source with a wavelength of 940nm. However, the intensity of the beam more than compensates.

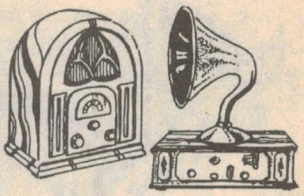
However this is not the case if you use IR LEDs. The obvious choice is an IR LED with an output wavelength of 940nm, and is the type which will be supplied with the kit. Some IR LEDs have lower wavelengths (880nm) and while they will work, the gain of the link will be lower.

If you are using the link as a perimeter guard, a suitable relay needs to be connected to the receiver board. The relay contact can then operate a buzzer or other warning device. The relay will be held on while the beam strikes the IR LED, making the system fail-safe.

Although the link operates with a line-of-sight beam, it can also work over an optical cable. It's beyond the scope of this article to give details, but the important thing is to terminate the cable properly at both ends to get the best results. But regardless of the medium used for the infrared beam, you'll be amazed at the results. ❖

Vintage Radio

by PETER LANKSHEAR



Capacitors in vintage radio — 2

Last month we looked at the evolution of the earliest types of capacitors, whose origins predated radio. These were adequate for pioneering radio equipment, which was very simple; but with the rapid progress in technology that came with the growth of the broadcasting industry, it was inevitable that new types of capacitors would be developed.

The *electrolytic* capacitor was the first to be evolved by the radio industry itself, rather than being adopted from earlier technologies. It was a case of the right component appearing at the right time.

Battery powering of receivers was never popular with broadcast listeners. They were expensive, and filament battery acid was corrosive; so efforts were soon being made to use mains power.

Practical AC heated valves were available from 1927, and for a while there remained a demand for mains power supplies for existing battery receivers. High tension battery eliminators using paper filter capacitors were quite successful, but filament battery eliminators were a different proposition. For adequate filtering of the large currents involved, capacitors of hundreds of microfarads were necessary — completely impractical with paper types.

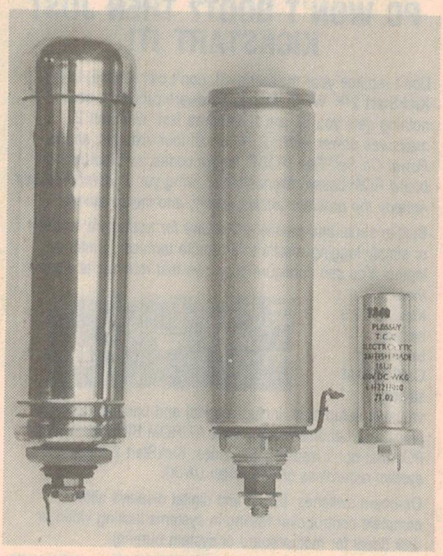
Filament battery eliminators did not achieve the same success as the high tension type, but from the search for a solution came the revolutionary electrolytic capacitor. This became an indispensable component for hum filtering and low frequency bypassing in valve receivers, and a generation later was to be essential in the new semiconductor equipment.

From rectifier to cap

The electrolytic capacitor actually evolved from the Noden valve electrolytic rectifier, a popular but messy type of rectifier for battery charging and eliminators. This device consisted of a container of electrolyte with a pair of electrodes, one of pure aluminium (or less commonly, of tantalum), the other an inert conductor, generally lead or carbon. A positive potential applied to the aluminium electrode builds up a molecularly-thin layer of aluminium oxide on its surface, effectively cutting off the current. As the polarity of the applied voltage is reversed, the oxide layer disappears, permitting current to flow.

Research during the mid 1920's showed that, provided the aluminium or tantalum electrode is maintained at a positive potential, the oxide layer is permanent and the same assembly can be used as a capacitor, with the oxide, the dielectric and the electrolyte functioning as the negative electrode. Aluminium and tantalum oxides are quite effective dielectrics, and the extremely thin layer provides a very high capacitance from a small electrode area.

The dielectric thickness is controlled by the initial 'forming' voltage, and governs both the breakdown voltage and the capacitance. A wide range of operating voltages is possible, in practice ranging from about three volts to a maximum of 600 volts. For a given electrode area, there is a relationship between capacitance and forming voltage.



A pair of cylindrical single-unit wet electrolytic capacitors became almost a standard for radio chassis of the 1930's. At left is an early Mershon copper-cased 10uF unit, while in the centre is an aluminium-cased Aerovox equivalent made in 1933, and still operational. At right is a Plessey 16uF dry electrolytic made 40 years later.

Conventional electrolytic capacitors have a wide capacitance tolerance, the nominal rating referring to the minimum capacitance. As with most components, electrolytic capacitors have steadily become much smaller.

'Mershons'

Electrolytic capacitors with tantalum electrodes and potassium hydroxide electrolyte were used for some filament supply eliminators, and it was necessary for the user to fill the capacitors with electrolyte during commissioning! Thereafter, the level had to maintained with distilled water, which was not much of an advance on the lead acid battery.

The demand for battery eliminators diminished with the advances in AC valve production, but the high tension supplies of the new receivers still needed hum filtering. Paper capacitors were satisfactory, but expensive and restricted to relatively low values of capacitance.

A common arrangement was to use two quite large chokes with paper filter capacitors, rarely larger than 4uF and frequently smaller. Low value capacitors had to be used with high inductance filter chokes.

Alternatively, smaller and cheaper chokes needed larger capacitors to produce a tolerable hum level. Either solution occupied a lot of space, with attendant weight and cost. (An alternative way to minimise hum, frequently used in American receivers for a while, was the push-pull output stage.)

There was some economy in using input chokes tuned to ripple frequencies, but any system was complicated, and a capacitor failure could be very expen-

Right: Mershon's production of the electrolytic capacitor coincided with the demand for high capacitance filters for the new mains-powered receivers. This advertisement, from a 1930 copy of 'Radio News', gives detailed instructions for using the revolutionary multiple filter capacitor.

Above: One feature of electrolytic capacitor development over the years has been the reduction in size. Top right is a 1950's vintage 8uF HT filter capacitor, with its modern 10uF equivalent at its left. Even more striking is the comparison underneath between the old (right) and new (left) versions of a 25uF 40VW cathode bypass unit.

Above: A wide range of ceramic capacitors is available. Those in the top row are Dutch, American and English types dating from the late 1930's. Those underneath are more modern components.

sive. What was needed was a compact, reliable and inexpensive capacitor of several microfarads capacity, capable of withstanding 500 volts or even more. High voltage electrolytics were the obvious answer.

The first of these electrolytic capacitors seems to have been made by the Mershon Company, which belonged successively to Amrad, Crosley, and then Magnavox. Until about 1930 (by which time well known brands including Ducon, Aerovox and Sprague were advertising the new filter capacitors), magazine articles often used the term 'Mershons' when referring to electrolytic capacitors.

Following on from rectifier practice, they were at first constructed in glass jars, but metal cans were soon found to be more suitable, copper and aluminium being popular. As well as being less fragile, metal had the advantage of making good contact with the electrolyte.

As these capacitors contained a liquid, they had to be mounted vertically; but major advantages were a significant reduction in size, and the fact that they were self repairing in the event of a breakdown! If the dielectric punctured from a voltage surge, as it did especially during warm up of valve cathodes, there was merely a short period of sizzling and bubbling as the oxide layer reformed, restoring normal operation.

By 1930, the single unit electrolytic filter capacitor had been standardised as a metal cylinder about 30mm in diameter and 120 - 150mm tall, rated at 8 - 10uF and 450 volts working. Before long, improvements had doubled the capacitance for the same working voltage and size of container and after 1932, paper filter capacitors were used in few new receiver designs.

Early in the evolution of the electrolytic capacitor, it was realised that as the electrolyte could be common to two or more capacitors. Thus it was practical to make multiple units in the one can, as shown in the Mershon advertisement.

Just as the liquid-filled Leclanche cell was adapted to become the dry cell, so the more convenient 'dry' electrolytic

capacitor soon evolved. This had an absorbent layer saturated with electrolyte between the electrodes, and this approach offered a wide choice of capacitances and working voltages.

The advantages of dispensing with a liquid are obvious, and as well, the dry electrolytic has a better power factor, much smaller size, lower leakage and frequently, longer life. It is, however, not as effective at self-healing; but the many virtues outweigh this disadvantage, and manufacture of the wet electrolytic was eventually phased out.

Another innovation, not entirely successful, was the packaging of dry electrolytic units into rectangular waxed cardboard boxes. Although mounting was simplified, sealing against evaporation was inadequate and as a consequence there were more frequent replacements.

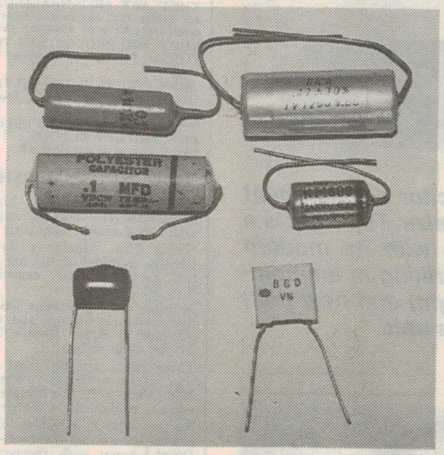
The dry electrolytic capacitor was able to meet a new demand. Cathode bias became more common with indirectly-heated valves, but for adequate bass response and hum reduction, bypass capacitors of 10uF or more were desirable. Paper capacitors would have had an unnecessarily high maximum voltage rating, with prohibitive size and cost.

Many receiver designs had dodged the problem by the alternative method of tapping off bias voltages from the power supply ('back bias'), but this was not as sound a method as cathode bias. Compact dry electrolytic capacitors rated at 25 volts and from five to 25uF were the answer, but initial unreliability meant that their adoption was not universal.

Limitations

In spite of careful sealing, early electrolytic capacitors tended to dry out, and corrosion could be a problem. Replacement of electrolytics became one of the commonest chores for radio servicemen.

Despite this, the weaknesses were gradually overcome and capacitors steadily became smaller as well as increasingly reliable. It is now difficult to imagine modern electronic equipment without the ubiquitous and inexpensive electrolytic capacitor. Today it is not at all uncommon to find filter capacitors that have given 40 years' service and that are still operating perfectly.



Plastic capacitors come in all shapes and sizes. At the top are Dutch and Japanese axial leaded examples, with similar Australian and German types in the centre. The two at the bottom have radial leads for PCB mounting.

The chief limitations are that in standard form, electrolytics are unsuitable for operation without some DC polarisation. There is always some leakage current, as well. There can also be a wide variation from nominal capacitance, which may change in time with operating voltage.

A major advance was made possible with 'etched foil' construction. By giving the positive electrode a matt finish, the active surface area was increased, significantly reducing the physical size of the capacitor. Note, however that etched foil capacitors have to be used with care when high ripple currents are present, or heating may occur.

Tantalum was originally used to a very limited extent for low voltage wet capacitors, but in recent years the tantalum electrolytic capacitor has become important in semiconductor equipment. These capacitors are very compact and have long and stable lives. However not having any self-healing properties, they are destroyed by voltage spikes and are intolerant of any voltage overloads. Such conditions are likely to be encountered in vintage receivers and consequently, tantalum capacitors have no place in valve equipment.

Ceramic capacitors

The *ceramic* is another class of capacitor essential to modern electronics. Its origins were in the 1930's, and there has been steady development and improvement ever since. Ceramics are minerals that have been modified and hardened by heat — the oldest, bricks and pottery, going back to antiquity.

As dielectrics, ceramics have many varied and useful properties.

Ceramic capacitors are versatile in that a wide range of required characteristics can be given them, simply by varying the mixture of materials in the dielectric. Some are similar in many ways to mica types, which they have largely superseded — but with the added advantages of very small size, a greater range of capacitances and working voltages.

One especially significant property which can be varied is the way capacitance changes with temperature. The temperature coefficient can be varied anywhere from negative through zero to positive. Negative coefficient capacitors are especially useful in stabilising oscillators against drift created by heat from valves and resistors, which can affect tuned circuits.

Increasingly popular after the mid 1950's, two main groups of ceramic capacitors were used in valve receivers. Most common are the general purpose high temperature coefficient ('high-K') types, which combine high capacitance with low inductance and are made in a wide range of working voltages and capacitance values.

As with electrolytic capacitors, the high-K types have a wide tolerance range and in valve receivers were used mainly for bypassing and audio coupling — applications taken over from paper capacitors. Generally in the form of round or square plates, 'blobs' and tubes, they have a very high insulation resistance, a wide range of working voltages and with capacitances up to about 0.25uF.

However with their high dielectric losses, high-K ceramics are unsuitable for tuned circuits. For this purpose, close tolerance, high stability ceramic capacitors, generally made in values below 1000pF are used in much the same way as the mica variety. Negative and zero temperature coefficient ceramic trimmers have been used for critical applications such as oscillator trimmers in

communications receivers, where frequency drift with heat must be minimal.

A specialised type of ceramic capacitor may be found in the detector area of valve receivers and can be a puzzle to the uninitiated in having three leads, one earthed. These are convenient composite units, used as diode load filters and incorporate a resistor — typically 47k ohms — with a pair of bypass capacitors connected, one at each end.

Fantastic plastics

For many years, although they had weaknesses, paper dielectric capacitors were unchallenged for applications requiring a non-polarised medium capacitance combined with relative cheapness, a good life expectancy, low leakage and reasonable efficiency. By today's standards, they were relatively bulky — mainly the consequence of unavoidable pinholes requiring the use of multiple plies of paper.

Another problem was susceptibility to moisture, and to achieve a long and stable life, elaborate impregnation and sealing was necessary. Although still made, paper capacitors have largely been displaced by the various *plastic* dielectric capacitors.

The first plastic dielectric did not challenge paper directly. Although various plastic materials had been available previously, *polystyrene*, developed in the 1930's, was the first to have significant value as a dielectric. Polystyrene capacitors are constructed in the rolled form, similar to paper types and are much the same size. With high insulation resistance, very low losses and excellent temperature stability, polystyrene capacitor applications are much like mica capacitors. Their chief application in valve radios was as padding capacitors for oscillator tracking.

It was in the late 1950's that the plastic dielectric revolution began, and various dielectrics including *polycarbonate*, *polyester* and *mylar* appeared concurrently with the emergence of semiconductor technology.

Today often known as 'greencaps', polyester dielectric capacitors were used to great advantage in the later generation of valve receivers. At that time they looked much like paper capacitors, with tubular shells and axial leads; but as the printed circuit increased in popularity, radial leads became more common.

As there is not the same problem of pinholes, multiple layers of dielectric are not essential. Plastic capacitors can be rolled or layered; some have metallising rather than separate foils, and applications are similar to the various paper types.

These capacitors have the advantages of compactness, low dielectric loss, long life and extremely high insulation resistance. Radio designers of the 1930's would have loved them!

Space has run out again, and there is still much to be said about capacitors in vintage radio. Next month we will look at variable capacitors, and for the beginner, there will be some practical hints on dealing with capacitors in servicing vintage equipment. ❖

Collector's Corner

Mr Brian Baker, of Russell, New Zealand, is trying to restore a University AST Signal Tracer, and needs a replacement meter movement. The meter is apparently a 500uA type, reading 5V-25V-100V-500V each side of centre zero when correctly set.

Mr Baker would also like to obtain copies of the manuals for two early AWA test instruments: the Signal Generator type 2R/7003 and Q Meter type A50589 (Serial No.8).

If there is anyone who can help Mr Baker, please write to him c/- *EA*.

Ego Tester

Continued from page 50

remains *high*, this indicates a rich mixture that is possibly caused by excess fuel pressure — or by the ECU again, as a result of either incorrect input sensor information or an ECU fault.

Sensor faults

There are two main causes of EGO sensor failure. These are by contamination, or physical damage. There are several ways that sensors can become contaminated, mostly from carbon, lead or silicone. Short runs on rich mixtures where the EGO does not reach its self-cleaning temperature (around 450°C) will cause carbon to build up in the sensor, making it ineffective. A good hard run should heat it up and burn off any built-up carbon.

Lead 'poisoning' of the EGO occurs when leaded fuel is used instead of ULP (unleaded petrol). Minor contamination can be removed by reverting to ULP use, followed by another 'good hard run'. Continued use of leaded fuel will eventually coat the sensor with lead, which will be impossible to remove.

When certain silicone sealants are curing, they release vapours (say from a manifold or rocker cover gasket). If these vapours are drawn into the engine and burnt in the cylinders, the residue flows out the exhaust valve and onto our waiting EGO sensor. Coating with this residue can be compared to dipping the sensor into molten glass (looks nice, but won't work again). It is important to practice safe sealing on engines with these types of sensors; use only sealants that are specified for this application.

Glycol-based coolants can also coat the sensor. This can occur if the head gasket blows, allowing coolant to pass through the cylinders, into the exhaust — you know the rest.

Turning now to physical damage, hard knocks to the engine or exhaust system both carry the potential to crack the zirconia thimble. Be careful if air chisels and the like are used to remove exhaust system components. Ensure that the sensor is clean externally, with no mud or paint etc., blocking the atmospheric vent. Another one to watch is damage from an ohmmeter. One sensor manufacturer tells me that a current flow of only 10uA (0.00001 amp) flowing through the EGO sensor will 'blacken' (that's another word for stuff-up) the zirconia, which causes it to lose its 'ion gathering' properties. This much current is easily supplied by most multimeters when they're set for the 'ohms' ranges.

EGO sensor ageing is a bit of a contentious issue. Many sources suggest that EGOs should be replaced on a regular basis, say around every 80,000 clicks. The sensor manufacturer referred to above suggests that if it is switching (in the manner we have discussed), then it is OK.

Future developments

The future will probably hold many changes for the EGO sensor. Since a single sensor located in a common exhaust manifold only reads the average of each cylinder's contribution to pollution, it cannot possibly compensate for the individual needs of each cylinder. As emission restrictions tighten up in the short years ahead, individual cylinder sensing of some kind is inevitable.

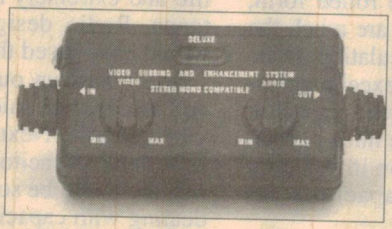
Another area of obvious change will be the development of sensors which can successfully measure leaner mixtures, for the coming generation of lean-burn engines.

I guess there is a lot more that could be said for this little device, but that is all I have for now.

I hope this subject has been of interest to those involved in the 'more traditional areas of electronics'. Incidentally, did you know that automotive engines still use valves? ❖

FEBRUARY MADNESS SALE!!!

SUPERBOOSTER VIDEO ENHANCER



If you dub from one video recorder to another, or from a camcorder to video recorder you should use a video enhancer. Enhancers are designed to minimise generation loss when dubbing, or to impose sharpness/detail for viewing.
Superbooster not only enhances the picture, it will increase the audio volume if need be. It can also be used to enhance playback viewing only. And, it's supplied with leads and gold RCA plugs. We,ve never seen a video enhancer for such a low price.

Specifications:

Video gain:	3dB	Plugs:	Gold RCA plugs
Video in/out imp:	75Ω	Power:	9VDC 200mA.
Audio gain:	20dB		Use Cat MP-3007 $15.95
Audio in/out imp:	10kΩ	Size:	100(L) x 55(W) x 35(D)mm

Input/Output cables: 800mm long

NEW for '94

Cat: AV-6500
$39.95

REMOTE CONTROL CAR ENGINE DISABLER

If you don't like the idea of a car alarm but still want the protection for your car, then consider this product. It's simply wired in series with the starter solenoid, and when activated causes an open circuit so the car cannot be started. Disabling the starter solenoid has other advantages, because it doesn't interfere with modern vehicles electronics, nor with the fuel injection system. The unit will beep and flash your indicators to confirm its state. One beep/flash for arm, and 2 beeps and flashes for disarm. It's very simple to connect - positive and negative, 2 wires to solenoid with spade lugs already fitted and 2 wires to indicators. Unit is black and all wires are black to help hide it. Even if the thief gets in and hot wires the ignition the car won't start. If the Engine Disabler is removed the engine still won't start.Supplied with two remote controllers which have two buttons - one for arm and one for disarm.

Specifications: Main Unit
Power: 12VDC
Dimensions: 122 x 72 x 38mm
Current drain: Standby 20mA
Sounding 350mA

Specifications: Remote Control
Transmit range: 14 metres
Power: 12VDC battery

Cat: LA-8925 **$89.95**

NEW for '94

NEW CATALOGUE - NEXT MONTH

FREE CABINETS WITH VIFA SPEAKER KITS

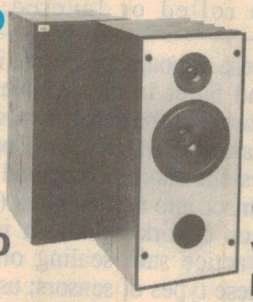
If you purchase a VIFA SA70,100 or 130 speaker kit in February we will give you the cabinets free. There has never been a better time to upgrade your speakers. It is well known that VIFA speakers generally perform as well as built equivalents that cost twice as much. We are overstocked with VIFA cabinets, and need the warehouse space. See catalogue for full details.

Vifa SA70 2 way kit

- Power 70 watts
- 8" woofer
- Dome tweeter

$349 Pair
Cabinets worth $120 FREE

Vifa SA100 2 way kit



- Power 100 watts
- 8"woofer
- Dome tweeter

$549 Pair
Cabinets worth $170 FREE

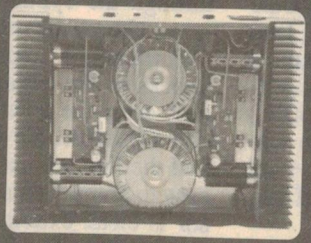
Vifa SA130 3 way kit

- Power 130 watts
- 10" woofer
- Dome tweeter

$779 Pair
Cabinets worth $250 FREE

PRO-SERIES THREE STEREO POWER AMPLIFIER KIT

185 WATTS RMS PER CHANNEL @8 OHMS



NEW for '94

REF: EA FEB/MAR 1994 Developed from the highly successful Pro Series One amp, this amplifier features a substantial increase in output power, a redesigned chassis with improved heatsinks and an even simpler construction method - with no increase in price over the previous design! This ambitious development came about after Electronics Australia and Jaycar carefully evaluated the original design - and noted several areas where a change would offer even better value for money. Based on the new flat pack power Mosfets, the new Pro Three incorporates two large 399VA toroidal transformers - amounting to an increase in output power of over 30%. The Jaycar kit is supplied complete with a professional punched and black anodised chassis, diecast heatsinks, punched and silkscreen front panel, toroidal transformers, specially imported filter caps, PCBs and all specified components., This kit is 100% complete as per the EA article.

SPECIFICATIONS

Power Output (per channel - with both channels driven)
- Continuous
  - 185W RMS into 8 ohms
  - 255W RMS into 4 ohms
- IHF (short term)
  - 240W RMS into 8 ohms
  - 380W RMS into 4 ohms

Distortion
- Total Harmonic (THD)
  - 0.005% at 100W RMS into 8 ohms
  - 0.008% at 180W RMS into 8 ohms
  - 0.009% at 240W RMS into 4 ohms
- Intermodulation (IMD) (50Hz/7kHz, 4:1 ratio)
  - 0.005% at 180W RMS into 8 ohms

Frequency Response
- -3dB points: 10Hz to 100kHz

Slew rate
- Approx 40V/us - defined by input filter

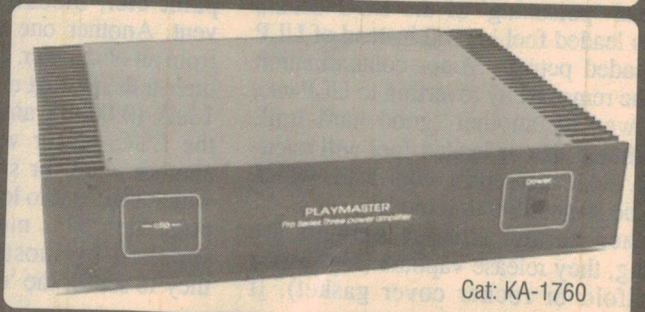
Input Sensitivity / Impedance
- 0.8V/33k for 100W into 8 ohms

Signal to Noise Ratio (unweighted)
- >100dB with respect to 100W RMS

Damping Factor
- >300 at 180W RMS into 8 ohms

Overload Indicator
- Activated if output THD exceeds approx 0.05% (regardless of load imp)

Cat: KA-1760
$599.00

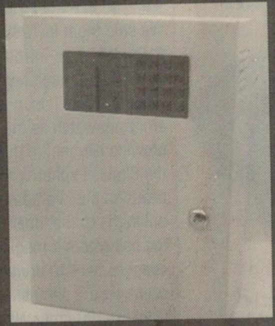


Cat: KA-1760

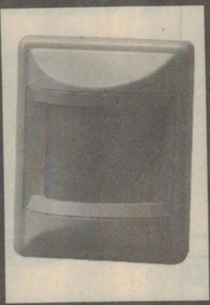
JAYCAR ELECTRONICS JAYCAR ELECTRONICS JAYCAR ELECTRONICS JAYCAR ELECTRONICS JAYCAR ELECTRONICS JAYCAR ELECTRONICS

BELLMATE ALARM EQUIPMENT - NEW UPGRADED PANELS!!!

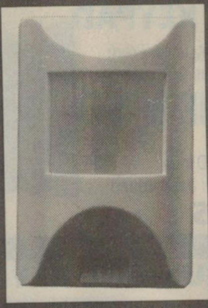
950 - 4 SECTOR
Cat: LA-5320
Price $149



1000 - 8 SECTOR
Cat: LA-5324 **Was $229**
Feb Special - Now $199



200 - PIR
Cat: LA-5017
$34.95



100 PIR - Pulse Count
Cat: LA-5016
$49.95

ALARM INSTALLERS
WHOLESALE PRCES
CALL ON (02) 743 5222

PLUS
KEYPADS Etc Etc

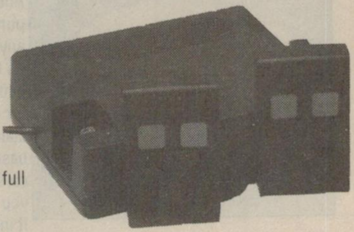
DIGITAL MULTIMETER BREAKTHROUGH!!!

Jaycar Electronics are proud to announce a brand new range of digital multimeters that offer features per dollar that until now was unheard of. Jaycar are sole representatives of this new range, which at the moment has three models, with more due in 1994.

QM-1300
•30 range •Large 21mm display •Transistor test •Audible continuity test •20 amp
Cat: QM-1300
$49.95

QM-1310
•Frequency •Capacitance •Transistor •21mm display •Audible continuity test •Auto power off •20 amp
Cat: QM-1310
$79.95

REMOTE CONTROL SWITCH SPECIAL

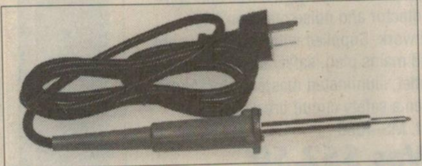


A quality remote control with two transmitters. Ideal for controlling central door locking, car alarms, garage doors etc. See catalogue for full details.
Cat.LR-8822
Was $79.95, Now $69.95, Save $10

THREE WAY X'OVER BARGAIN

Limited quantity. Power handling 60WRMS. Crossover frequencies 1kHz and 2.3kHz. 6dB/octave slope for woofer, 18dB/octave slope for tweeter. Special price which is about half price. Cat. CX-2617 **$10 each**

BUY 10 LESS 10%

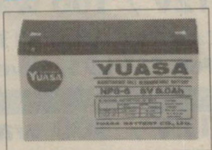


JAYCAR SOLDERING IRON

Ideal for the hobbyist and handyman. Our lowest price 240 volt quality iron has a stainless steel barrel. 25 watt.
Cat. TS-1450 **Was $17.95**
Feb $12.95 Save $4.00

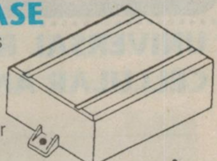
Dear Customers:
Our current stock of Vinnic brand rechargable batteries bears a logo which may be interpreted as meaning that these batteries are capable of being recycled. We wish to point out that no recycling facilities currently exist in this country for the recycling of batteries. They can however be recharged up to 1,000 times. If you have previously bought Vinnic batteries from us in the belief that they were capable of being recycled in this country, please return them to us if you so wish, & obtain a full refund of your purchase price.

LAST CHANCE - 8AH 6V LEAD ACID BATTERIES



This is your last chance to grab a bargain 8AH 6 volt battery. We have these at the very low price of $16.95
Cat. SB-2478 **$16.95**

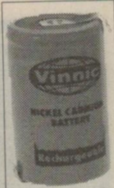
LOWER PRICES ON BULKHEAD MOUNT PLASTIC CASE



A unique screw together case that features moulded in mounting feet on the sides. Measures 87(L) x 67(W) x 31(D)mm. Ideal for car burglar alarms, etc. Black in colour. Manufacturers contact us for lower wholesale prices. Cat. HB-6075
Was $3.25, Now $2.75
WHOLESALE DEPT
100 + $1.45 plus 21% tax

MADE

4AH D NICADS



Quality Vinnic brand.
Cat. SB-2462
Only $10 each, Were $13.95 Save $3.95

12V GREENAIR NEGATIVE ION GENERATOR

See catalogue for full details. Cat. YX-2912
February Price $17.95
Cat Price $24.95 Save $7

SAVE ON YOUR POLYSWITCHES

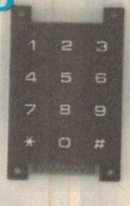
Save your speakers from being damaged, and save money this month on polyswitches. See catalogue for full details.

Description	Cat No	Normally	NOW
Tweeter Protection	Cat: RN-3410	$6.95	$4.95
Mid/Woofer Protection	Cat: RN-3415	$7.95	$5.95
200W System Protection	Cat: RN 3418	$10.95	$7.95
300W System Protection	Cat: RN 3420	$12.95	$9.95

JAYCAR WILL NOT BE UNDERSOLD ON GOODS OF THE SAME QUALITY

JAYCAR ELECTRONICS JAYCAR ELECTRONICS JAYCAR ELECTRONICS JAYCAR ELECTRONICS JAYCAR ELECTRONICS JAYCAR ELECTRONICS

12 KEY NUMERIC KEYPAD



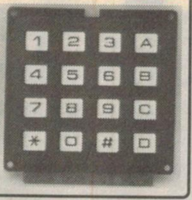
This telephone style keypad has many uses. From hobbyists to security situations. It has 0-9, asterix, # - 3 x 4 way matrix.
NEW for '94

Specifications:

Contact rating:	20mA, 24VDC
Size (Key Face):	44(W) x 54(H) x 5(D)mm
Colour:	White keys on black background

Cat: SP-0770 **$6.95**

16 KEY ALPHA NUMERIC KEYPAD



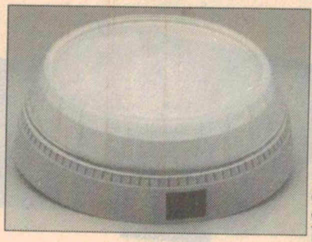
Ideal if you need more keys. this one has 0-9, asterix, #, A, B, C, D - 4 x 4 way matrix.
NEW for '94

Specifications:

Contact rating:	20mA, 24VDC
Size (Key Face):	65(W) x 59(H) x 7(D)mm
Colour:	White keys on black

Cat: SP-0772 **$8.95**

EVEREADY ANYWHERE LIGHT



Another surplus stock purchase. The anywhere light runs on two "D" size batteries and is ideal for use in closets, stairwells, attics, basements, camping, cars - anywhere where you need some light. It incorporates an on/off switch, and the light is from a torch globe. Size: 159(dia) x 50(deep)mm. These used to sell for around $25.00. We have a limited quantity available for only $9.95.

Cat: ST-3035 **$9.95**

8" SUBWOOFER

As used in subwoofer project in Electronics Australia June 1992. The speaker features a massive magnet assembly, 80W RMS power handling, butyl rubber cone suspension and a super rigid frame. Copies of the project are available for viewing at Jaycar stores.

Rated Power	80 watts rms
Frequency Response	35 - 5kHz
Sensitivity	90dB - 1W/1m
Free Air Resonance	41Hz

Cat. CW-2150

Norm $99.50, Feb $69.50, Save $30

8" PLASMA LAMP

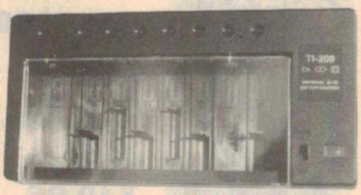
NEW for '94

We sold them in 1988/89 for $199. We've re-introduced them in 1994 at a much lower price. Plasma lamps look pretty amazing. watch as the red glowing element in the centre of the 8" glass sphere projects beautiful blue lightning outwards to the inner surface of the ball where it magically changes back to crimson. This event occurs simultaneously at least 50-100 times all over the inside of the sphere and is constantly in motion. It is truly beautiful to watch. The intensity of the display can be controlled by a slider pot mounted in the attractive base. In addition you can trigger the performance by means of a sensitive sound activated circuit.

This beautiful instrument will give countless hours of pleasure and relaxation.It requires 12VDC at 1 amp to operate. Use plug pack MP3015 $24.95 (not supplied) to operate from 240VAC.

Cat: YP-5000 **$129.50**

12V DC DELUXE NICAD BATTERY CHARGER



This unit will charge one to eight NiCads at a time. It will charge 9V, N, AAA, AA, C and D batteries.This handy charger also includes battery tester and LED charge indicators. Charger comes with a 2.1mm DC socket on the side of the unit, which enables you to use any 12V DC source 500mA or more, eg. plug pack (MP3012 $22.50), car, boat or even a solar Panel. No need to rely of 240V AC to charge your NiCad batteries!!

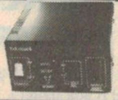
Cat MB-3514

Was $17.50, Jan $12.50, Save $5

SAVE UP TO $50 ON INVERTERS

If you have been considering the purchase of an inverter lately, make it this month and save money. All units have inputs of 12VDC (except MI-5060) and outputs of 240VAC. For full specs and details see our 1993 catalogue.

12V / 100 watt



Cat: MI-5035 **Was $134.95**
Feb $114.95, Save $20

12V / 500 watt

Cat: MI-5050 **Was $419.00**
Feb $379.00, Save $40

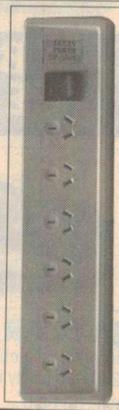
12V / 300 watt

Cat: MI-5040 **Was $259.00**
Feb $229.00, Save $30

24V / 1000 watt

Cat: MI-5060 **Was $649.00**
Feb $599.00, Save $50

SIX WAY POWER OUTLET WITH MAINS FILTER

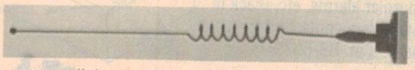


Not only is it a 6 way power board, it incorporates a voltage surge and spike protector and noise rejection filter network. Supplied with two metre cord and mains plug, safety shutters on each outlet, illuminated master on/off and even a safety circuit breaker.

Cat. MS-4030

Was $52.50
Feb Special $39.95
Save $12.55

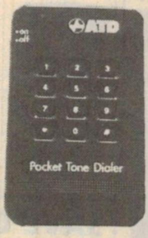
UNIVERSAL REPLACEMENT CELLULAR ANTENNA



Has your cellular antenna been lost, broken or stolen!! Well Jaycar now stock a universal replacement antenna for under $20. Replacement whip and base supplied. Frequency 800 - 926MHz • VSWR less than 1.6:1 • Gain 3dB • Impedance 50 Ω nominal • Power 50 watts continuous • Radiation pattern omni-directional.

Cat. DC-4050 **ONLY $19.95**

TELEPHONE TONE DIALLER BARGAIN



GENERATES DTMF SIGNALS

For use in conjunction with telephone answering machines, remote banking, computers, electronic voice mail and call diverters. Was selling for $19.95. Now an amazing half price. Not Austel approved. Cat: YT-6155

Was $9.95 Feb $5.00

9 V RECHARGEABLE BATTERY BARGAIN

Normally
$19.95
February
$15.00
Save $4.95

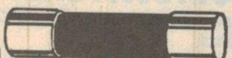
Cat: SB-2458

SEVEN SEGMENT DISPLAY SPECIAL

No. LT303 Common Cathode Red Display Cat: ZD-1803

Normal Price $3.50
February 10 for $10

CERAMIC FUSES



These fuses are used in microwave ovens and precision equipment. They are fast acting and rapidly respond to a fault condition. They are sand filled and their interrupting capacity is 1500A at 240VAC.

M205 (5 x 20mm)	3AG (6.35 x 30mm)
6.3A Cat: SF-2110	7A Cat: SF-2120
8A Cat: SF-2112	8A Cat: SF-2122
10A Cat: SF-2114	10A Cat: SF-2124

$1.50 each

NEW for '94

ALL SPECIALS AVAILABLE UNTIL END FEBRUARY ONLY!!!

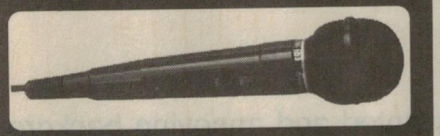
MICROPHONE MADNESS

If you are in the market for a mic, buy it this month & save real money. For full details see our catalog.

LOW COST DYNAMIC

Cat. AM-4090

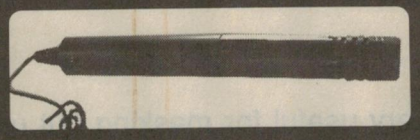
Was $15.95 Feb $11.95 Save $4



LOW COST WIRELESS

•Transmits on FM Cat. AM-4072

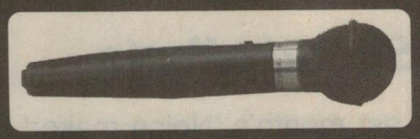
Was $21.50 Feb $16.50 Save $5



UNIDIRECTIONAL WIRED AND WIRELESS MIC

•Best of both worlds Cat. AM-4076

Was $49.95 Feb $39.95 Save $10



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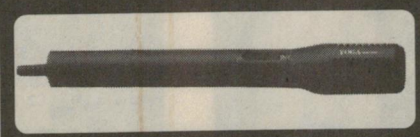

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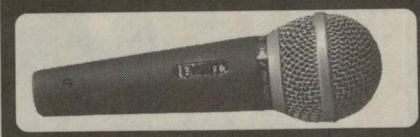

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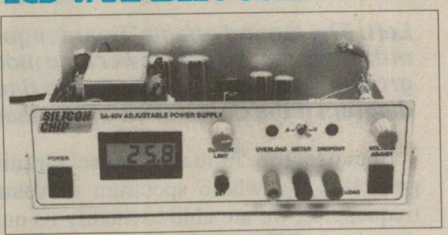

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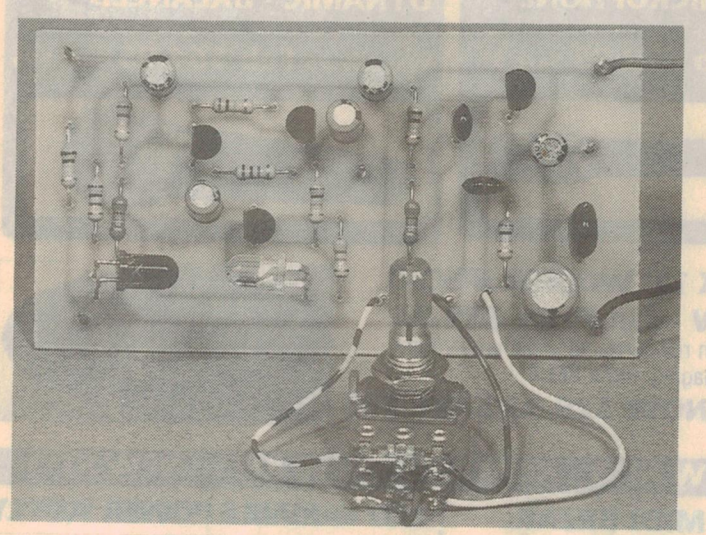
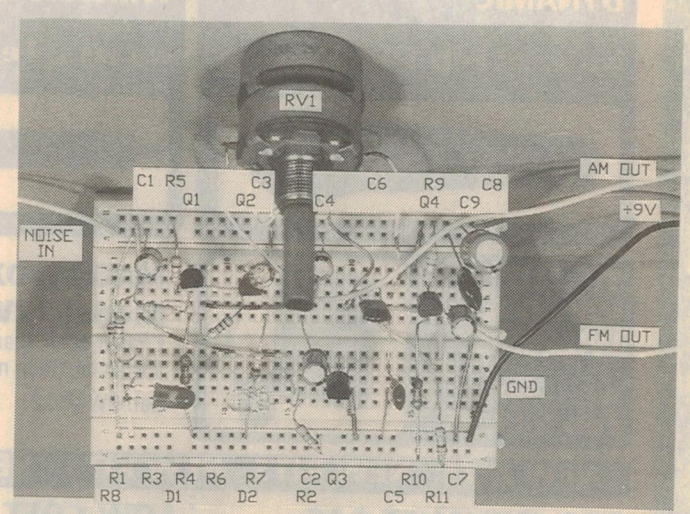
Experimenting with Electronics

by PETER MURTAGH

Sound effects

Last month's 'Noise maker' is very useful for masking out unwanted and annoying background sounds. But if you want to make special effects like a steam train chugging along, the wind howling in the trees, or a wave crashing on the beach, then you need to build this add-on unit to modify the continuous output of last month's unit.

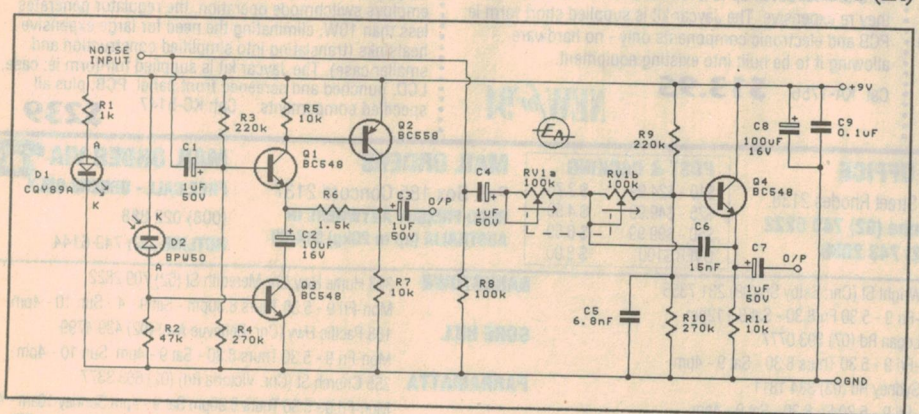




Left: The 'sound effects' board requires input at the left from the 'noise maker' project (January 1994), while either of the outputs is sent to the 'power amp module' (December 1993) to obtain a comfortable listening level. There must be a common ground connection between the three boards. Right: Here's the breadboard layout. As usual, check with the schematic diagram if the destination of any lead is not clear in the photo.

Because the January 'noise circuit' generates the whole spectrum of sound frequencies, we are able to modify its output in two different ways to create special effects — change either the amplitude or the frequency. Sound familiar? (remember our radio circuits). I suppose we could call this project our *AM* and *FM* noise maker! (where the 'M' would stand for *modification* rather than *modulation*).

A quick inspection of the schematic diagram shows the two separate circuits for the amplitude and frequency modification. On the left we have an infrared (IR) diode source and an IR diode detector, which we use to modify the amplitude of the output signal, by adjusting the gain of the two-transistor amplifier (built around Q1 and Q2). Transistor Q3 is being used like a variable resistor to achieve this.



The schematic shows the 'AM' circuitry on the left (including the IR emitter and detector diodes) which adjusts the amplitude of the noise output. The 'FM' filter on the right uses pot RV1 to vary the frequencies in the output signal.

On the right we have a second-order Butterworth low-pass filter, where we can alter the cut-off frequency by adjusting the variable resistor RV1. So when the dual pot is turned down (anti-clockwise), only very low frequencies are able to pass through to be amplified; but when turned up, the tone of the noise changes because many more frequencies are now present.

The nature of a Butterworth filter is that it has a very flat response before roll-off occurs; and being a second-order filter, that roll-off occurs at 12dB per octave. Remember that last month we had the opposite problem — a simple resistor-capacitor (RC) filter has a roll-off of 6dB per octave, but we wanted a 3dB one to change white noise into pink. This time,

to get a quicker change in our sound effects, we want to double the normal roll-off rate, rather than halve it.

Construction

Commence construction in the normal way, soldering first the low profile and more robust components like resistors and capacitors. Then it's time for the transistors, taking care that the *only* PNP transistor (Q2) is not confused with the other three NPNs.

Now take some care with the infrared source and detector diodes. First make certain that you have correctly identified which is which: the diode with the blue lens (CQY89) is the emitting diode (our D1), while the one with the clear lens (BPW50) is the receiver diode D2. (The Jaycar catalog numbers are ZD-1945 and ZD-1950, respectively.)

Next identify the anode and cathode on each — the cathode has the longer lead. A multimeter with a diode tester can also be used to identify the leads on D1, giving a lower voltage when forward biased. The lower reading means that the positive lead of the meter is connected to the anode and the negative to the cathode. This test doesn't work with D2, which is the IR detector. But the clear lens allows easy inspection of the diode's internal structure — in common with all LEDs, the cathode is the larger of the two electrodes which you can see.

Now it's time to bend the leads so that the two LEDs face each other. Notice on the schematic that D1 is *forward biased* (the anode is connected via resistor R1 to the +9V supply rail), while D2 is *reverse biased* (the cathode connects directly to the rail). To try to make this a little less confusing, we have designed the PCB so that the leads of the two diodes are oriented in the same direction, with both anodes being inserted in the holes closer to the top of the board. So use a pair of pliers to grip the leads of each diode about

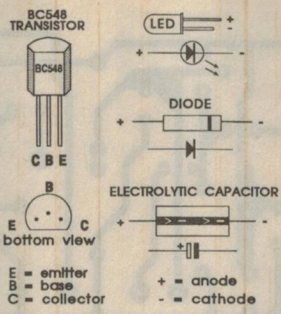


Fig.3: Here is the familiar diagram to identify the leads on the common components used in our projects.

5mm from the body — with the cathode lead closest to you. The body of D1 should be to the right of the pliers, while that of D2 will be to the left. Holding the pliers, bend the leads around them until they make an angle of 90°. The two diodes can now be inserted so that they face each other. When you solder them to the PCB, leave them standing some 15mm above the board (see the photo). This will allow you easily to move a piece of cardboard or plastic between them, in order to modify the noise output.

Note, however, that this same lead orientation is *not* the case with the strip-board and breadboard versions of the circuit. For these, the two anodes (and hence cathodes also) of D1 and D2 are positioned on opposite sides. So when bending the diode leads, hold both with their heads pointing to the right (and their cathode leads closest to you).

When we designed this board under the fluorescent light in our workshop, we found that the tube emitted sufficient IR to keep diode D2 turned permanently on, even with D1 off. So we made a small tube of cardboard to cover D2, so that it would react only to the IR from D1.

Of course, to use this month's project, you also need the 'Noise maker' circuit from last month to provide the input signal, as well as the 'Power amplifier module' from December to produce the modified noise at sufficient volume. Fig.1 shows where the noise signal and ground wires are connected from the noise source, and where the output and ground continue on to the amplifier.

Some special effects

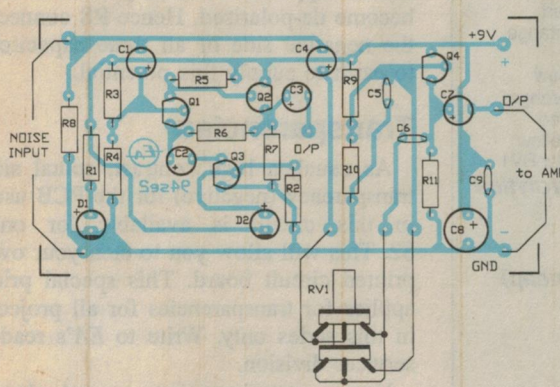
Try producing the sound of a steam engine as it gradually builds up speed. Move a piece of cardboard (an old credit card is ideal) in and out of the gap between the two diodes. As the train speeds up, move the card in and out at ever increasing speed. You might try a competition to see who can 'drive' the train the fastest!

Next try to create an ocean wave crashing onto the beach. The build up will be slow, but a quick termination is needed for the crash. This process is very difficult to do with amplitude variation, so switch over to frequency control and try again. You will find rotating the dual-gang potentiometer a far easier mode of control. (Adjusting the pot back and forth can also make that haunting, eerie sound of the wind howling in the trees.)

Unfortunately, you can't alter both amplitude and frequency controls at the same time. So it's over to you to decide which control makes the more realistic sound for each of your applications. Happy experimenting with your sound effects. You will probably be surprised to discover just how many sounds are just modified forms of white noise.

Changes

Remember that controlling the IR beam controls the amplitude of the noise output. So, if you wish to further increase the sensitivity of your control over the beam, try increasing the resistance value of R1 to decrease the intensity of the IR beam. Don't reduce it too far, since this could stop transistor Q3 turning fully on. What you are really trying to do is to match the



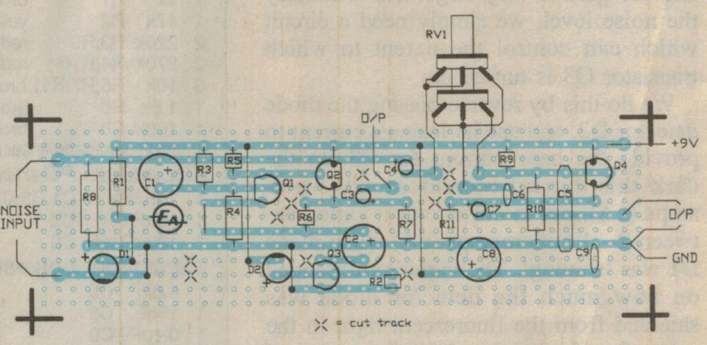


Fig.1(left): The component layout for the PCB. Note that the board has been designed to allow both diodes to be oriented the same way — with their cathodes closer to the ground track — even though D1 is forward-biased and D2 reverse-biased. Fig.2 (right): The layout diagram to build the circuit on strip-board. Break the copper track at all the locations marked.

full scale of beam interruption to an audible change in sound output.

Another change that you can try is different values for capacitors C5 and C6 in the 'FM' section. (C6 must be twice C5, as is explained in the 'How it works' section.) Increasing or decreasing these values alters the roll-off point of the filter. For example, doubling the 6.8 and 15nF values would result in your output having more bass. With clockwise rotation, the higher frequencies which previously could not be heard until the half-way position was reached, now do not appear until it is rotated to three quarters. More lower frequencies are heard at all positions, but fewer high ones.

Of course reducing the values of C5/C6 will have the opposite effect. You will have more treble in your output; but a full anti-clockwise rotation may not roll off the higher frequencies sufficiently for your liking.

How it works

The arrangement of transistors Q1 and Q2 should be quite familiar, as we have used it many times before — a complementary Darlington pair amplifier. As usual there is 100% DC negative feedback (via resistor R6) for stability, with an AC potential divider determining the amount of AC negative feedback. This is quite easy to see if you imagine transistor Q3 as a (variable) resistor. Then the feedback fraction is the voltage produced across capacitor C2 and the transistor, compared to that across this network *plus* across R6. And of course the gain is related to the inverse of this feedback fraction.

When transistor Q3 is turned fully off, it effectively has an infinite resistance. In this position, the AC feedback approaches 100%, so the gain goes to unity. At the other extreme, the feedback is minimal, and the gain is very large. So, to modify the noise level, we simply need a circuit which can control the extent to which transistor Q3 is turned on.

We do this by reverse biasing the diode detector D2, and use its leakage current to provide the base current for Q3. In the dark this current measures only nanoamps (nA), but in our circuit it varied between 2 - 10 microamps (uA) when diode D1 was 'shining'. The variation depended on how much the detector diode was shielded from the fluorescent light in the room. So, if you want the noise output of your unit to cut right out when the IR from D1 is blocked, then you must cover D2 with some form of tube.

Some measurements we made will show just how effective the use of this leakage current can be. With a 1k current-limiting resistor R1, the current flowing through the emitting diode D1 measured 13mA. The amount of IR produced when diode D1 was connected via R1 was sufficient to cause the leakage current in receiver diode D2 to rise to from 5uA to 10mA — over a thousand-fold increase! Since this provides more than enough base current for Q3, controlling the IR beam can fully control the transistor.

The workings of the Butterworth filter are a bit harder to follow. In this design there are only two variables, 'R' and 'C'. The resistance of each of RV1a and RV1b is 'R' — hence the need for a dual-gang pot to keep each resistance the same. The value of capacitor C5 is 'C', while that of C6 is '2C'. The equation to determine the 'break frequency' (the -3dB roll-off point) for this filter is:

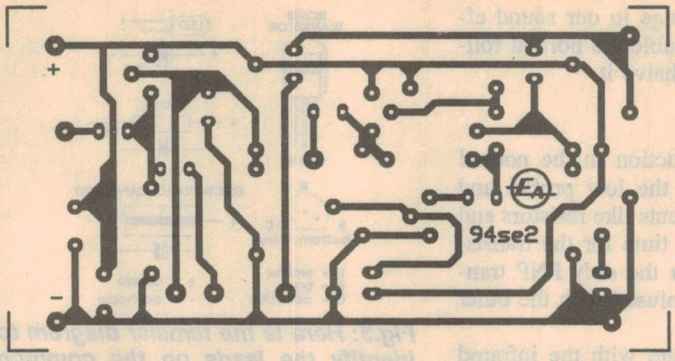
$f = 1 / (2\sqrt{2}\pi RC)$

With the pot set to maximum resistance, this gives a low-pass filter which theoretically blocks off all frequencies higher than 165Hz. As you decrease the resistance, you will find that the cut-off frequency rises proportionally.

Because the load resistor R11 is connected to the emitter of Q4, the transistor is set up as an emitter-follower amplifier, which gives close to unity gain. It simply acts as a buffer to isolate the input and the output, with capacitor C6 providing feedback between the two. Capacitor C5 is connected to ground, and so supplies a low impedance (AC) bias point. The roles of these two capacitors are complex. Not only do they form RC filters, where their impedance decreases with increasing frequency, but they can also introduce phase changes which can end up making positive feedback become negative!

For example, capacitor C6 would seem to provide positive feedback, since there is no phase change between the input at the base and the output at the emitter of transistor Q4. But if a phase change of 180° were to occur at some particular frequency, then that frequency would be completely removed from the output. Unfortunately, a mathematical analysis is needed to explain the complex interaction of all the components in the filter.

The role of R8 is that of a bleed resistor for the electrolytic capacitors C1 and C4. Because these two capacitors join to another electrolytic — the output capacitor on the 'noise maker' — a DC potential must be applied so that they don't slowly become de-polarised. Hence R8 connects the negative side of all three capacitors to earth to supply this potential.



The PCB pattern is given here actual size for those who wish to etch their own board.

PARTS LIST

Miscellaneous

PCB 88 x 46mm, coded 94se2
9V battery
hookup wire, solder, etc.

Resistors

All 1/4W, 5%

1	1k	R1	brown-black-red
1	47k	R2	yellow-purple-orange
2	220k	R3,R9	red-red-yellow
2	270k	R4,R10	red-purple-yellow
3	10k	R5,R7,R11	brown-black-orange
1	1.5k	R6	brown-green-red
1	100k	R8	brown-black-yellow
1	100k dual-gang linear potentiometer RV1		

Capacitors PC-mount electrolytics

4	1uF,50V	C1,C3,C4,C7
1	10uF,16V	C2
1	100uF,16V	C8

Capacitors polyester (greencap)

1	6.8nF	C5
1	15nF	C6
1	0.1uF	C9

Semiconductors

1	CQY89 IR emitting diode	D1
1	BPW50 IR receiver diodes	D2
3	BC548 NPN transistors	Q1,Q3,Q4
1	BC558 PNP transistor	Q2

Transparencies

As usual, a high contrast, actual size transparency (negative) for the PCB used in this circuit is available for only $2. This will allow you to etch your own printed circuit board. This special price applies for transparencies for all projects in this series only. Write to *EA*'s reader services division.

Happy experimenting — and please send us your comments on the circuits we have published, as well as ideas for future projects. ❖

(Continued from page 45)

Hams earn their access to the bands by having SOME (or more) technical competence, no matter what class of licence. Also, they have the unique privilege of being self regulated.

We should be able to say that self-regulation means that anyone with a vested interest in their bands and operations will actively take part in the perpetual endeavour to keep what is considered to be a reasonable standard of practise. Everyone has to 'do their bit'. Which means for example, if you hear a pirate then get a beam heading and report it.

I have heard on two metres remarks which engender the attitude of 'Anyone who wants to be on the bands should HAVE to do Morse, because I did it' — which is positively rustic and stunted at best. Surprising, considering that radio is on the leading edge of technology and has been ever since licences were introduced — and hams have been one of the leading groups of contributors to its rapid march forward.

Packet instead of Morse?

After all, isn't Morse a poor man's manual digital mode? Why not make it a requirement for any class of licence to have either Morse or packet as a prerequisite to being granted a licence. Times HAVE changed! As it is, people obtaining a 'codeless' licence want to be on the bands to run packet.

Considering the message handling capacity of packet and the remote repeating capability, this is not a bad idea when you realise that you would be creating an excellent data network which could be activated by organisations like WICEN in times of emergency. What a valuable community resource!

We have to remember that Morse was made a licence requirement, back in the early days, because it was the best way of 'getting a vital message through' under worst case conditions.

For the same reason it was then considered desirable to have that alternative community network — the Titanic disaster was one incident that solidified that thinking — I am sure that with modem-like features such as automatic fallback and error correction, so too could packet with a greater throughput. Has anyone ever conducted Morse versus Packet trials under worst-case conditions?

To hold the opinion that the amateur bands be 'Morse exclusive' and to ostracise and ignore on-air those codeless 'new chums' is only going to do the amateur service a great disservice, by discouraging others to take up even that class of licence. Considering there was a possibility that part of the two metre band looked like being taken from the hams only a few years ago, and the 70 and 23cm bands have oodles of spectrum — for the most part seldom used — one must remember the adage 'Populate or lose it' which was touted at that time.

Slowly doing away with Morse, like the passing of the horse and cart, is a fact of life and when one looks at the advances in radio, over even the last 20 years it is of course inevitable, perhaps even too long coming.

It can also be argued that those who resist, either passively or actively, are NOT practising the amateur creed of promoting and furthering the Amateur Radio cause. Perhaps it should also be realised that Morse requirement in this day and age is a deterrent, to anyone who may have the other kinds of required technical expertise from joining the amateur ranks.

This is true in my own case, and I always thought it was ridiculous to have to learn it when a better form of transmission was available: RTTY. Bearing in mind that I have always agreed with the philosophy that the hams form the basis of an alternative emergency network.

I already possess the required technical competence for a Full-Call licence, however I have no intention in putting in the effort to learn Morse which I would never use once I was granted such a licence. With the resistance and ostracisation as pointed out by Tom, it will be a while before I will yet bother to obtain any class of licence.

CBers earn their access by paying a small fee to have their equipment licensed, and all we can hope for is extended vigilance by the licensing body to ensure that this equipment and their operational procedures run to spec. At present this is far from the case! The CB bands are useless... so too are certain of the ham bands.

Continuing with my line of reasoning as to a natural resource still further, I was alarmed to hear of the US government recently banning receivers capable of tuning to the 800MHz cellular phone band, perhaps in response to concerns raised by the 'Dianagate' affair.

Banning anyone from access to receiving any band would be like telling the residents of Sydney not to breath whenever the wind blows hot and dry from the southwest, because it has issued from the hallowed hc ls of that public-bankrupting eyesore — New Parliament House.

If any lawful user of the bands wishes to have their transmissions secure from general access then they must employ the necessary techniques to make it so, not lobby governments into passing ineffective and unconstitutional statutes.

Anyone want to take bets on how long it will be before the US government is forced to withdraw that law, in the face of litigation by an enraged citizen?

Pager interference

Conversely, we have the right to expect also that we should be able to have access to our band of choice without interference. However, for the last two years two metres has become more and more unusable due to that often talked and complained about problem: PAGERS.

Power levels were doubled for these pesky transmitters and intermod has quadrupled — yet nothing much seems to have been done. Perhaps the problem would be tackled and output filters be prescribed if WICEN were to tell the powers that be, that due to the interference experienced which will not abate — the network on two metres is becoming unreliable and may have to be suspended, until such time as the SMA deals with the problem at its source. A possible future source of problems could also be the cellular and digital phones.

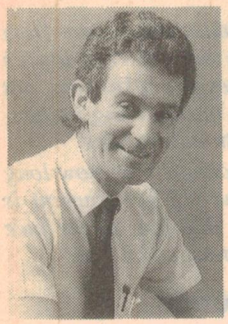
The point of what I am saying is that we all have an interest in the spectrum in one way or another, and we should all contribute — each according to our standing and interests. Either ham or CBer or citizen must exercise their voice and TELL the government and its arms how we require our natural resource to be managed; and also whether we think they are doing enough or not — either through our organisations or directly by correspondence.

At present, it is apparent that both sides are not performing their duties. This of course is an evolutionary process, just like the technology involved.

I apologise for my apparent verbosity, but I have harboured these thoughts for quite some time. I enjoy Tom's anecdotes and humour but must say I also enjoy it when he gets serious — he has stung me into writing this.

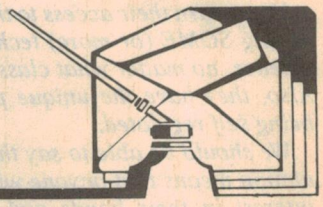
Well, there you are. Thanks, Robert, for your comments, which are certainly quite thought-provoking. I like your comment that it is really the responsibility of every radio amateur to clean up anti-social behaviour on their bands — because of the way hams won the right to self-regulate.

But that's really all we have space for, this month. I hope you'll join me here again next time. ❖



Information centre

Conducted by Peter Phillips



A car antenna controller, tape deck speed and more

This month starts with a mini review of a device I'm sure you'll find interesting. There's also the usual reader ideas, comments and questions — including a request for a rundown on the difference between an average and an RMS value.

It's not every day I get a letter with a postscript 'Peter Phillips will be surprised to know I'm still alive.' I had already read the letter and found it interesting, so it was quite a surprise when I realised it was from a colleague I'd worked and socialised with some 15 years ago, but whom I'd not seen since.

A phone call followed, and within a few days we met to discuss many things, including the subject of the letter. It turns out that after retiring, my colleague has perfected a device that I think warrants a description here. I don't normally review or promote products in this column, but this device is unusual, even unique, and bound to interest quite a lot of readers.

It's called an Automotive Power Antenna Controller, which really doesn't tell you much. The photo of Fig.1 probably doesn't help either, except to show you the device is rather small, measuring 33mm square by 25mm high. There are five connections, and a single control. But there's an amazing amount packed into this tiny package.

These days many cars are fitted with electrically-operated aerials; some that operate automatically when the radio is turned on, others operated by a separate switch on the dashboard. This device lets you convert the latter type of aerial to one that operates automatically when the radio is turned on. That is, when you turn on the radio, the aerial extends; turn off the radio and the aerial retracts again.

However, it does more than that. A common problem is that most automatic aerials start extending the instant power is applied to the car radio. Usually the radio is left turned on, so when you start the car, the aerial does a little dance — extending then retracting as the supply voltage varies during starting. This device introduces a four-second delay before the aerial starts to extend, eliminating this annoying behaviour.

The controller is designed to replace the aerial dashboard switch, so all you now see is the potentiometer control. This control adjusts a timer within the controller, giving you amazing control over the height of the antenna.

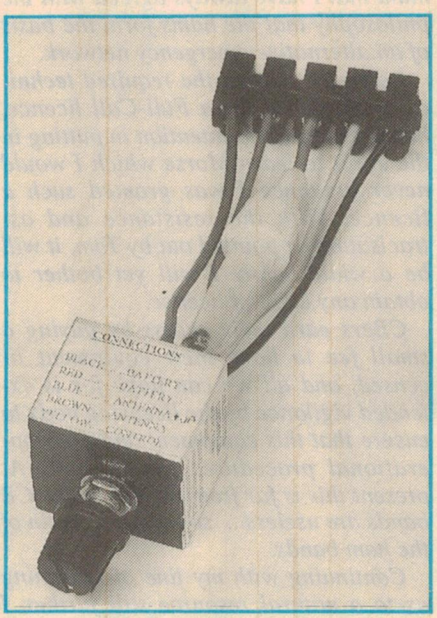


Fig.1: This tiny device can control virtually any type of electric car aerial. Switch on the radio and up pops the aerial. This happens after a four second delay, so you can start your car first, without it doing a 'dance'.

For instance, if you want to listen to a cassette tape, wind the control fully anticlockwise and after switching the radio-cassette on, the aerial won't extend at all. You can set the control so the aerial extends halfway (perhaps to miss low hanging trees), or to any height you want.

A preset potentiometer at the back of the assembly is used to adjust the retract time, which is usually longer than the extend time to ensure that the aerial fully retracts.

The controller can handle a load current of over 6A, and an external fuse protects the electronics. There's even reverse voltage protection, in case you mix the polarity of the supply during installation.

The diagram of Fig.2 shows how the controller is connected. Two wires connect to the aerial, two from the 12V supply and a fifth, called the control wire, connects to the car radio. Most car radios made in the last 10 years have an output terminal called the control output, especially for automatic aerials. This terminal goes to +12V when the radio is switched on, and is simply a connection from the on-off switch.

While this arrangement suits most aerials, some aerials have a different arrangement in which the aerial motor is reversed by switching the positive supply from one lead to another. A different model controller is needed here.

To the best of my knowledge, there's no device on the market quite like this ingenious controller. My colleague kept the circuit details to himself, because as he explained, he has spent many years perfecting it, and then designing it to fit into a ridiculously small package. He doesn't want anyone to pinch the idea. Of course, as he also explained, if someone wants to discuss buying the rights, then that's a different matter.

I've seen the controller working, and even if the designer had been unknown to me, I would have still wanted to

described it. It really is an inventive and well-engineered little device, which many people will want. And it's Australian made!

If you want more details, write to Antenna Controller, PO Box 31, Leichhardt, NSW 2040. The price of the unit is $49.95. When you consider that most automatic car aerials (like that fitted to the Commodore) are priced at $200 or more, you can see why I'm so excited.

And now to more usual matters...

Cable locator

The next letter asks for what should be a useful and relatively simple project...

Would it be possible for you to develop a cable locator? I have seen a telephone technician use a device that injects a signal, which must be just into the radio range, and trace it with a receiver, which has a variable sensitivity, so the cable can be traced to its terminal box, then located within the box. I think when the correct pair is shorted, the transmitter changes tone.

Some cable locators can trace underground cables, but this is not what I currently need, as I am working in an old factory, where there are many old power cables. Some of these are live and others are not. (R.M., Auckland NZ)

I was sure when I read this letter that *EA* had developed a cable tracer of some sort. But not so. The nearest I can find is a Mains Cable Seeker in the May 1980 issue of *ETI*, and a Pipe and Cable locator in *ETI* April 1980.

So it would seem time to think about such a project. No promises, but it's a good idea R.M., and we'll see what can be done.

Power supply

On the subject of projects, here's a letter that starts with a few comments about *EA*, then asks for a project that we have certainly done more than once.

I am writing for two reasons, one to ask for help and the other to state an opinion.

In the August '93 edition, correspondent D.S. wrote about what's wrong with EA. My view is quite different. I have found EA to have a few things I don't understand, but that's to be expected as it's a technical magazine.

EA keeps me up to date with new products and technology, it also shows me how far the field has advanced with 'When I Think Back' and the 50 and 25 years ago segment. There are also always a few general interest articles.

Admittedly I don't make your projects and I'm not interested in fixing VCRs, TVs and so on. However, EA is the only magazine I can read cover to cover and find something good on every page.

Now my request for help. I was wondering if you intend developing a bench power supply for hobbyists and technicians alike. Perhaps a supply with +5V, +/-12V and +/-15V outputs, and a variable voltage supply, with current limiting. (P.D., Rockingham WA).

Thanks for the kind words P.D., it's good to hear positive comments now and then. Regarding the power supply project, we have done quite a few over the years. These include the Powermate II Power Supply in October 1988, the 18V/1A Benchtop Supply of August 1991, and a Dual Tracking Power Supply in February 1987. Of course there's also the 40V/3A Lab Supply which Rob Evans has just described, in the December and January issues.

None of these have *everything* you specify, but it's a simple matter to produce a fixed voltage power supply by using a 3-terminal regulator. The main work is in the variable supply, and as you can see, there's quite a few to pick from.

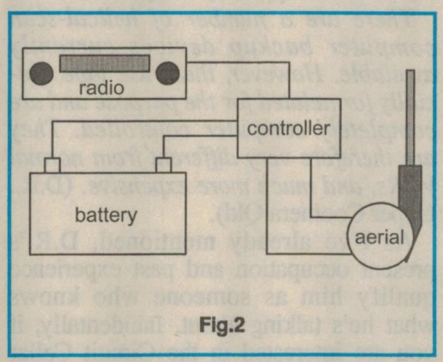


Fig.2

SigChecker

The next letter concerns the Signature Analyser described in August 1993.

I have just finished the SigChecker project, and find that when I test low and high resistance, the meter needle slams hard upscale. This is because the 50uA meter is carrying 28V/22k or 8mA. I added a 56k resistor in series with the 22k resistor, which reduces the slamming effect, but not the sensitivity.

Also, correct me if I'm wrong, but the LO position of Switch 2 on the circuit of Fig.2 (page 66) seems to be incorrectly marked. In the LO position, the 47k resistor is bypassed, giving high current to the circuit. When switched to the HI position, the current will in fact be low. (D.C., Narangba Qld).

I think you might be using the signal checker incorrectly, D.C. It works by comparing the waveforms at two supposedly identical points in two separate but identical circuits. Therefore, when testing the unit, connect two identical components (resistors will do fine) between points P and K and points Q and L. If these components are different in some way, the waveform developed across them will be slightly different. The difference is then amplified and indicated on the meter.

If you connect one component only, the difference between the waveforms will be significant, and possibly cause the effect you mention. However, I see no reason why R17 (originally 22k) could not be increased in value to prevent damage to the meter.

The LO/HI indications of SW2 are correctly marked. If you read the circuit description, you'll see that the LO indication means the checker can be connected to a low impedance node in a circuit. Hence the series resistance is relatively small at 1k.

In the other position, the series resistance is effectively 48k, suitable for supplying a high impedance circuit.

A tautology

I occasionally get letters like the following...

Re Information Centre, September 1993. Electrocution is 'to be killed as a result of an electric shock.'

However you say 'Most deaths due to electrocution are from the mains...' This gives credence to the common, but unfortunate view that the terms electric shock and electrocution are synonyms. Or am I being pedantic? (G.P., Dunedin NZ).

Of course you're right, G.P. It's a tautology all the way, where according to my statement you die of death. This is rather like the common expression of the 'reason why'. As a friend of mine says, give me the reason or tell me why, but don't give me the reason why!

Multi-adaptor

I wonder who'd be game enough to try designing the device requested by our next correspondent...

After glancing through some old issues of EA, I noticed a recurring theme in your correspondence. Many people ask that you design add-on devices for their brand of computer.

Surely it's possible to design an intelligent adaptor that can translate the I/O commands from any PC to any peripheral. It would open the door to everyone, not just IBM owners.

Also, I think an article on mainframe computers would be of general interest, as there is more to the world than PCs. Congratulations on EA, I think you've

struck a good mix of topics and you've created a friendly feel to the magazine. (D.O., Nambour Qld).

Thanks for the kind words D.O. At first glance it seems a reasonable thing to suggest that some sort of black box could be used to interface any peripheral to any computer.

I own two computer systems, Apple and IBM, and I often despair at their differences. But when you add the Amiga, Commodore and all the other brands, it's a truly daunting task. About the only common I/O port to all computers is the serial port, but even the types of connectors differ. Parallel ports also have some similarity, but again the connectors are often totally different.

And of course, there's the software to drive the device. Despite the best efforts of programmers, there's still no language that all computers recognise. BASIC and C were supposed to be universal, but even simple things like hardware differences between computers make it impossible to write a program that works on all computers.

We haven't written any articles on mainframe computers, although their applications often appear. It's a good idea and one we'll give some thought to what can be done.

VCR backup

While we're talking about computers, here's a bit more about using a VCR as a hard disk backup device, from a reader who has been involved professionally in the field:

In the October 93 issue of EA, a reader once again brings up the idea of computer backup to VCR.

There is a complete construction article for such a device in Vol.1 of The Circuit Cellar Project File, edited by Steve Ciarcia. The project was designed by Winifred Washington.

The article also discusses some of the error mechanisms inherent in the approach, and the extent to which the author had to go to overcome only partially the problem of dropouts.

There is a big difference in tape oxide formulations for analog video recording and digital data recording. Analog formulations are usually trying to achieve maximum dynamic range, often of the order of 80 to 90dB, and momentary dropouts are not a real problem because of the inherent redundancy due to the nature of the information being recorded. Digital recording usually only needs a 20dB dynamic range, but minimum dropouts because there is usually no inherent redundancy, especially if compression is used to remove all redundant information.

Those who have tried to use computer data tapes for audio recording will remember how terrible the reproduction is. This is mainly because the oxide surface is not suitable. Using a VCR to record digital information has many problems. Over the years a number of commercial products have been released, but none satisfactorily overcame all the problems. A major difficulty is that most VCRs have to be manually operated, and cannot be automatically started and stopped by computer.

There are a number of helical-scan computer backup devices currently available. However, these use tape specially formulated for the purpose and are completely computer controlled. They are therefore very different from normal VCRs, and much more expensive. (D.R., Upper Coomera Qld).

As I've already mentioned, D.R.'s present occupation and past experience qualify him as someone who knows what he's talking about. Incidentally, if you are interested in the Circuit Cellar project, the address of the Australian agents is CEBUS Australia, PO Box 178, Greensborough, Vic 3088. You can phone them on (03) 467 7194.

Tape deck speed

We stay with tape recorders, but of the audio type...

I compose music using digital synthesisers, and I recently bought an extra tape deck to use with others I already own. However, I was shocked to notice a change in tone when using this deck to play something recorded on another deck.

So I decided to do a time test of a number of tape decks. To do this I played a 30-minute tape on each deck and timed it with a stop watch. I found variations of up to a minute between the decks. I also recorded a middle C tone on one deck and played it on another. It was several tones lower, so I sent the playback deck back for repairs under warranty. Nothing was done to correct it, and I'm pursuing the matter further.

Perhaps EA could compare the speeds of some of the decks currently on the market. We all assume they run at 4.8cm/s, but not so it seems. What happens if a DAT recorder runs slow? (B.H., Flying Fish Point, Qld).

Tape deck speed has always been a problem. Like you B.H., I've experienced similar problems, where music recorded on one deck is several tones higher or lower when played on another. This becomes a significant issue if the music is an accompaniment, as singers are likely to run out of range.

Tape speed is more consistent on higher priced decks, as the motor speed control system is more sophisticated. Some decks even have a front panel control to vary the playback speed. But cheaper decks are often suspect.

It's an interesting idea for us to make some comparisons, although I'm sure we would find the same thing you have. And there's no guarantee that if sample deck brand A runs at the correct speed, all others by that manufacturer would be similarly accurate.

A DAT recorder is somewhat different, as it uses helical scanning to give a much faster relative tape speed. Data read from the tape is also stored in memory, for subsequent processing and conversion to analog. Speed variations therefore have no effect on the music, as the data is read out of the memory at a rate determined by a crystal-locked clock.

Tape deck problems

The next letter is also about a tape recorder, but this time a reel-to-reel unit (remember them?). I think the writer may be on the wrong track somehow...

I have written to a number of suppliers trying to track down parts for a Ferguson reel-to-reel tape recorder. It's an old valve type, and being an amateur I'm having a little trouble finding the fault. The symptom is all bass, and no treble — the music before the voice. So I've decided to replace all the capacitors. However most of these are rated at 250 to

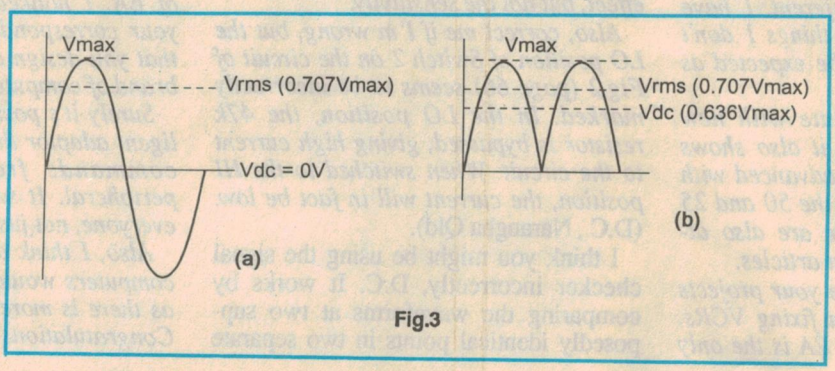


Fig.3

350V and I can't find anyone who deals with high voltage capacitors these days. Can you suggest someone who sells these components? (D.H., Rubyvale Qld 4702)

From the symptoms you describe D.H., I think the problem is more likely to be the record/playback head. By all means replace the capacitors, as they are likely to have deteriorated anyway, but I doubt if this will fix the problem.

It's very common for head wear in a tape recorder (either cassette or reel-to-reel) to cause a loss of high frequencies. Usually the only solution is to replace the head. Given the age and brand of the recorder, I doubt if you'll be able to get such a replacement.

To confirm what I'm saying, examine the head under a magnifying glass and look for wear (flattening) at the point of contact between the tape and the head. If the wear is only slight, you might improve things by cleaning the head thoroughly by wiping it with a cloth dipped in isopropyl alcohol. Alternatively, use methylated spirits, but make sure there's no deposit left when the metho evaporates.

Several companies sell high voltage electrolytics, including Farnell Electronic Components. Their address is 72 Ferndell Street, Chester Hill, NSW 2162, phone (02) 645 8888.

RMS and average

If there's a topic bound to cause confusion, it's the difference between an RMS value and an average value. The next letter has been condensed to extract the main points, which are...

First let me thank you. You mentioned in your column several years ago that anyone with appropriate experience could get an electrician's licence. As I had what I considered the right experience, I followed this through and I now have my Gold licence and I'm back working with my hands. Many thanks.

Secondly, in your June 93 column you discussed RMS and average power; but I got confused the way it was written. According to a textbook I've got, average voltage is 0.636 of Vmax and is defined as the value that would be indicated by a DC meter.

The RMS value is given as 0.707 Vmax and is defined as the effective value of the voltage. Would you please elaborate. (D.H., Annandale, NSW).

I'm glad one of my comments was able to help you D.H., and good luck in your new line of work. Regarding the RMS and average values, in June '93 I discussed power, not voltage or current. However I'm happy to elaborate, as quite a few people get average and RMS values confused.

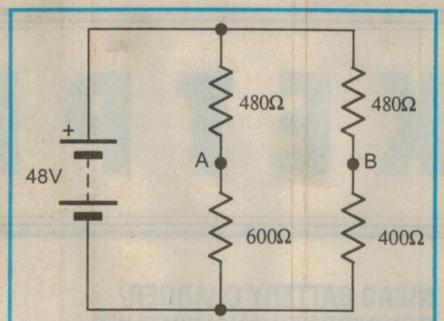


Fig.4

The average value of a waveform is also its DC value. You can see this in Fig.3. In (a) the DC value is 0V, as the average of the positive and negative half cycles is zero. In (b), both halves of the sinewave are positive (after rectification). Because the average of half a sinewave is (as you say) 0.636Vmax, the average or DC value of the waveform in (b) is 0.636Vmax.

The RMS value is unchanged in both waveforms at 0.707Vmax. The confusion that arises is the definition often given to RMS, which is the value that has the same heating effect as a DC value. That is, 240V RMS has the same heating effect as 240V DC.

But the DC value of a sinewave is zero, as I've just explained. This should be obvious when you realise that a DC meter connected to read an AC value must read zero, as it spends as much time trying to read upscale as downscale. So RMS is *equivalent* to a DC value, while a DC value is the average value of the waveform which is usually zero anyway. Average and RMS power are totally different, as explained in June '93.

Solution to January What??

$P_1 = 6I^2$ W

$P_2 = 41.6666$W

$P_T = 35I$ W

as $P_T = P_1 + P_2$

$35I = 6I^2 + 41.6666$

or

$6I^2 - 35I + 41.6666 = 0$

the solutions are found with the equation

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}, \text{ so}$$

$$x_1 = \frac{35 - \sqrt{35^2 - (4 \times 6 \times 41.6666)}}{12} = 1.6666\text{A}$$

$$x_2 = \frac{35 + \sqrt{35^2 - (4 \times 6 \times 41.6666)}}{12} = 4.1666\text{A}$$

substituting $I = 1.6666$A

$V_1 = IR_1 = 1.6666 \times 6 = 10$V

$V_2 = P_2/I = 41.6666/1.66666 = 25$V

note that $V_1 + V_2 = 35$V = battery voltage

$R_2 = V_2/I = 25/1.6666 = 15$ ohm

substituting $I = 4.16666$A

$V_1 = IR_1 = 4.16666 \times 6 = 25$V

$V_2 = P_2/I = 41.6666/4.166666 = 10$V

note that $V_1 + V_2 = 35$V = battery voltage

$R_2 = V_2/I = 10/4.1666 = 2.4$ ohm

Fig.5

What??

We have a classic question this month, given to me by John Zervos (Abbotsford NSW). John asks: An apprentice is asked to measure the voltage between points A and B in the circuit of Fig.4. However, instead of having the meter on the 20V range, he incorrectly sets it to the 20mA range. What is the reading shown by the meter?

Answer to January's What??

There are two answers to the problem. The first is a current of 1.6666A and a resistance for R2 of 15 ohms. The second is a current of 4.16666A with R2 equal to 2.4 ohms. The solution is shown in Fig.5, in which a quadratic equation is developed and the two possible solutions to the quadratic are found in the usual way.

Substituting the two current values back in the circuit shows that both are valid, giving two different values for R2. ❖

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THE SERVICEMAN

Continued from page 31

Recently the lady went to an appliance dealer to try to source the missing part. However they were very busy at the counter and while she was waiting, she had a look at a couple of similar machines in the showroom. The filters were all the same!

So what does that mean? Surely there can't be thousands of dishwashers out there that all behave as badly as this one. Or perhaps I'm not the only one who refers to them as @$#!?! dishwashers! Or as the lady put it: "Does this mean you have to wash up before you use the dishwasher...?"*

(In this instance, since it's a lady speaking, you will omit the @$#!?! and read 'dishwasher' simply as 'dishwasher'...)*

Well, K.W. All I can say is that I'm glad it was you and not me, in there among the watermelon seeds and bits of onion! Seriously, though, I think that story will be of interest to a lot of readers.

I know that electronics was barely mentioned in K.W's narrative, but many readers will own dishwashers and this story will help them when their own machines need attention. Then again, we all need to be able to do first-aid repairs to our domestic appliances. Just last week my wife told me that our washing machine had stopped working and that I'd better do something about it, quickly.

After bailing out many buckets of hot soapy water, I turned the machine upside down and found a stuck pump. Dismantling that item revealed a lady's handkerchief wedged firmly between the rotor and the pump housing. Now I'm in the poo — because the hanky got torn in the process, and the machine dropped water on the floor while it was upside down. Ya just can't win!

Incidentally, have you ever noticed that although ladies' noses are much the same size as a gent's proboscis, their handkerchiefs are only a quarter the size? Probably accounts for why there are always four times as many of them in the wash! Anyway, K.W., thanks for your story. We look forward to hearing from you again. But please, electronics next time, eh!

Don't forget. Reader's stories can earn a contributor's fee if they're used. And we are always looking for amusing items for 'Just for a Laugh!'

Bye, until next month. ❖

READER INFO NO. 13

50 and 25 years ago...

'Electronics Australia' is one of the longest running technical publications in the world. We started as 'Wireless Weekly' in August 1922 and became 'Radio and Hobbies in Australia' in April 1939. The title was changed to 'Radio, Television and Hobbies' in February 1955 and finally, to 'Electronics Australia' in April 1965. Below we feature some items from past issues.

February 1944

700mph wind tunnel: A new wind tunnel is being built at Pasadena, California, jointly financed by the Consolidated, Douglas, Lockheed and North American aircraft firms. Costing over $2,000,000, the tunnel will be capable of testing speeds up to 700mph.

Jet-propelled fighter: Fighter planes, driven by jet propulsion and without the usual propeller, have successfully passed experimental tests and will soon be in production in Britain and America. The fighter is capable of very high speeds, probably up around the 600mph mark, but its fairly high fuel consumption might limit it to high speed short-range missions.

Group-Captain Frank Whittle began designing the jet engine in 1933 and had them running successfully in 1937.

February 1969

Microwave diodes: Two Japanese companies, Hitachi and NTT, have developed a special purifying process which increases the electron mobility in gallium arsenide crystals to a level close to the theoretical limit. This affects the time taken for electrons to travel through the crystal of a diode base, which in turn limits the frequency response.

In practical experiments, a GaAs Gunn diode was used as an oscillator, replacing a conventional klystron. During 8500 hours of continuous operation, the GaAs device achieved outputs of 150mW at 13GHz and 250mW at 10GHz.

Passive microwave repeater: In Sunnyvale, California a microwave communications system carries test data between two works plants, separated by a mountain range, by using passive repeaters.

The system consists of a transmitter-receiver unit with a 10ft diameter 'dish' antenna at each end, plus a pair of 14 by 16ft aluminium 'billboard' reflectors at a midway point on top of a mountain.

The concentrated beam is directed towards one of the 'billboards', and is reflected towards the second close by, which redirects the beam to the receiving antenna. Two reflectors are needed as the required change of direction of the beam is small, and a single reflector at a shallow angle would not achieve effective reflection.

Navigation simulator: A training simulator developed specially for navigation training, instead of purely pilot training, has been developed in the UK and is to be supplied to the RAAF. The RAAF version will have 12 student cabinets.

The simulator is digitally controlled by two HSD DCC-2 computers, whose output is used to drive display instruments digitally by stepper motors. The electronic circuitry is modular in construction, with plug-in printed circuit boards. ❖

EA CROSSWORD

ACROSS

1. Section of the radio spectrum. (4,9)
8. Radio enthusiast. (7)
10. Feature of some giant stars. (7)
11. Check performance. (4)
12. The meaning of supra, the opposite of infra. (5)
13. Vector product based on a differential operator. (4)
16. Inventor's protection. (6)
17. Collection of reference material. (7)
19. Metallic element used in thermocouples. (7)
21. Reduced the brightness of light. (6)
23. Battery stick, or cattle ----. (4)
25. Controls. (5)
26. Famous French physicist, 1774 - 1862. (4)
29. Lightest metal. (7)
30. Element that melts at 30°C. (7)
31. Said of the work/heat relationship. (13)

DOWN

1. Electrocardiographs monitor these. (6)
2. Test tubes, beakers, etc. (9)
3. Short insulated cable. (4)
4. Disentangle wires, etc. (7)
5. Significant point in wave interference. (4)
6. Well known brand of radio and electronic equipment. (5)
7. Visible information on a screen. (7)
9. Automation. (5)
14. Substances through which energy passes. (5)
15. Weapon based on fusion. (1-4)
18. Radioactive element in smoke detectors. (9)
19. Unwanted fluctuations in rectified current. (7)
20. Lowest value. (7)
21. Remove hidden microphones. (5)
22. Kind of clocks on NAVSTAR GPS satellites. (6)
24. Group of eight. (5)
27. Fundamental physical quantity. (4)
28. A project with a purpose. (4)

SOLUTION FOR JANUARY 1994

K	E	N	N	E	D	Y	■	N	E	U	T	R	A	L
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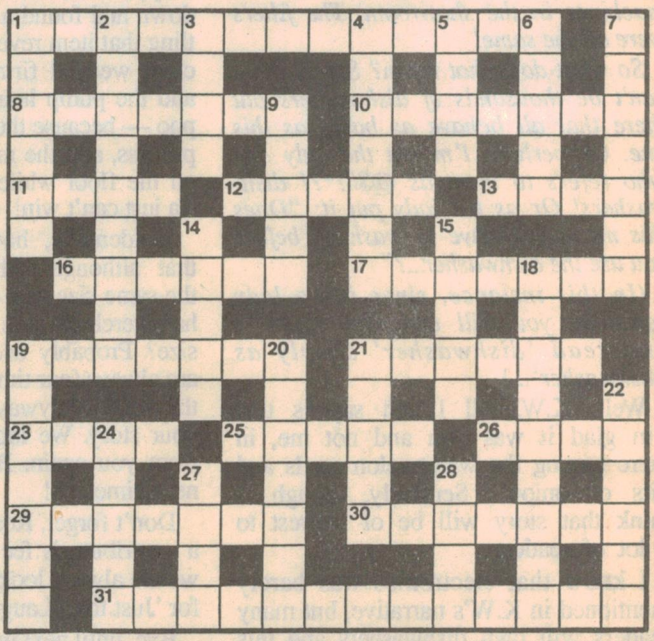


Electronics Australia's

Professional Electronics

S·U·P·P·L·E·M·E·N·T

PRODUCT REVIEWS:

- **NEW LOW COST 12MHZ DDS CARD FOR PC'S**
- **COMPACT HIGH-TECH 12/240V INVERTERS**
- **PC PACKAGE FOR FAST BUSINESS/TECHNICAL GRAPHS & TABLES**

INTEL'S NEW WIRELESS MODEM FOR LAPTOPS AND PORTABLES: USING CELLULAR RADIO TO AVOID THE CONNECTION HASSLES...

NEWS HIGHLIGHTS

HUBBLE REPAIR MISSION SUCCESS

In early December last, the seven-astronaut crew of NASA's STS 61 mission successfully carried out their tasks to repair the orbiting Hubble Space Telescope, and returned safely to Earth. During the mission they replaced the telescope's faulty gyroscopes, solar power panels and Wide Field Planetary Camera, and also fitted the COSTARs, or 'corrective optics space telescope axial replacements', designed to correct the spherical aberration in the telescope's primary mirror.

Testing is now under way to confirm the operational success of the Hubble repairs. We hope to present a full follow-up feature story on the mission in our next issue, written by our space correspondent Kate Doolan.

JAPAN BACKS UNSW VANADIUM BATTERY

Two large Japanese industrial and energy companies have signed an agreement for collaborative R&D of the vanadium battery technology developed by a team at the School of Chemical Engineering and Industrial Chemistry at the University of NSW, headed by Professor Maria Skyllas-Kazacos. The agreement will find three years of research by UNSW's Vanadium Battery Group, under the continued direction of Professor Skyllas-Kazacos.

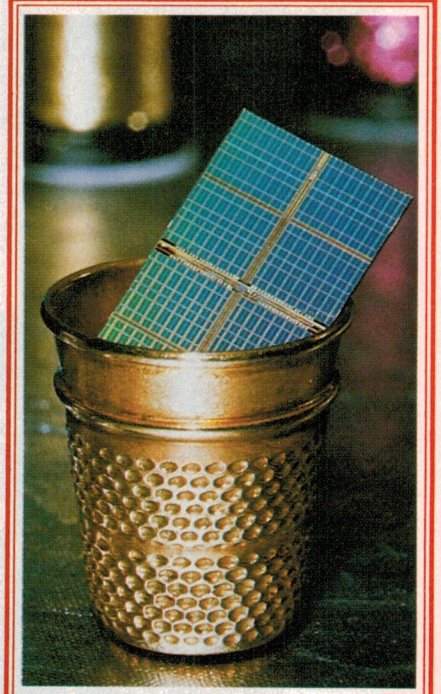
The two companies are Mitsubishi Petrochemical Co Ltd and Kashima-Kita Electric Power Corporation. Mitsubishi Petrochemical is the largest petrochemical company in Japan, with sales of 525 billion Yen in 1992. The company spent about $300 million on R&D in 1992. Kashima-Kita is a subsidiary company, specialising in electric power generation and storage.

The UNSW research will be directed towards upgrading the technical performance and reducing the costs of the group's vanadium battery, and preparing it for a load-levelling role in the large-scale production and delivery of electricity.

Mr Akira Shibata, Assistant General Manager in the Corporate Planning Division of Mitsubishi Petrochemical, said the difference between daytime and night-time demand for electricity in Japan has recently increased. "In summer, especially, demand during the day is about 2.5 times the demand at night", he said. "How we are to meet such a high demand peak has become a serious issue for all electric power companies in Japan."

"We had decided that vanadium battery technology would be one of the most effective methods of storing power for load levelling, and we began to develop this technology by recovering vanadium from fly-ash from a boiler plant at Kashima-Kita, in 1987."

"After learning of Professor Skyllas-Kazacos' excellent achievements in this field, we decided to obtain a licence from Unisearch (UNSW's technology transfer company), in order to collaborate our research efforts on the technology."



IBM and Siemens have developed this 64-megabit DRAM chip in the USA, and have started providing functional samples to selected customers. The chip measures 18.1 x 10.7mm, and was developed using advanced 0.35 micron CMOS technology.

AKIO MORITA, SONY FOUNDER HAS STROKE

Mr Akio Morita, co-founder and recently executive Chairman of Sony Corporation, has suffered a cerebral haemorrhage and is expected to give up most of his business activity. Mr Morita was taken to hospital in Tokyo after he fell ill while playing tennis, and underwent surgery.

Mr Morita, 72, played a crucial role in founding Sony in post-WW2 Japan, and has become respected around the world for his vision and ability to predict future trends in consumer electronics. He has also written very successful books.

SPICE DATA ON COMPUSERVE

US-based circuit simulation specialist firm Intusoft, well known for its IsSpice simulator for IBM-compatible and Macintosh PCs, has set up a SPICE bulletin board on the popular Compuserve Information Service. The BBS contains SPICE models, technical applications, software utilities and demonstration software.

The BBS is in the CADD/CAM/CAE forum, and can be reached by typing 'Go CADDVEN' at any '!' prompt, followed by selection of the 'All CADD/CAM/CAE' section. The Intusoft Compuserve address for direct e-mail is 71564,3147. Internet users can send e-mail messages to Intusoft technical support staff by using the address format '71564.3147@compuserve.com'.

Further details are available from Intusoft's Australian distributor ME Technologies, phone (065) 50 2200.

HONG KONG HAS CABLE TV

Eight years after the idea was first mooted, Hong Kong's cable TV service has been launched by Wharf Cable. Some 300,000 homes are connected, in housing estates in Shatin.

The network's initial eight-channel package includes a 24-hour news channel — the first in Asia, and the first in Chinese in the world — with locally produced news and programmes from China Central Television (CCTV). Other channels feature children's activities,

sports, movies, youth music, previews and entertainment.

In 1994, Wharf will enter its second phase with new channels for women's affairs, learning, Hong Kong lifestyles and English news and business (to be covered by CNN International).

CENTRAL COAST FIELD DAY

The Central Coast Field Day, by tradition the premier annual amateur radio event in Australia, is being held at Wyong Racecourse, Howarth Street, Wyong on Sunday February 27. The racecourse is only a five-minute walk from Wyong station.

Attractions of the day will include trade displays and sales, displays by the WIA, WICEN and other amateur radio organisations, seminars and technical lectures. The disposal sales and 'flea market' activities featured in previous field days will also be held.

Trading and programmed activities will begin at 9am, with $8.00 admission fee for adults and $5.00 for pensioners. Children under 12 will be admitted free.

A field day information service will be provided on the Gosford two-metre repeater (146.725MHz) on Saturday afternoon and Sunday morning, using the callsign VK2AFY/P. Further information is available from the Central Coast Amateur Radio Club Inc., PO Box 252, Gosford 2250; phone (043) 40 2500.

SONY CD PLANT FOR SYDNEY

Sony Corporation has signed a Fixed Term Arrangement (FTA) agreement with the Australian Government. The FTA Agreement recognised the commitment by the Sony group of companies in Australia to developing the local music and entertainment industries. It also recognises Sony's intentions to take advantage of converging information and communications technologies to foster the emerging multimedia industry.

The Managing Director of Sony Australia Limited, Mr Shinsuke Yoshida, said "Sony Corporation is clearly focused on the information age. Our core business is information in its many forms: electronics, music, video and electronic publishing. Through the FTA, Australia now has a key role to play in our plans for this industry".

Sony's FTA Agreement builds upon a strategy investment in a new CD manufacturing facility at Huntingwood, west of Sydney.

The $30 million investment in world-class CD manufacturing included significant expenditure on the most advanced CD production equipment and acquiring leading edge skills and technical know-how for over 30 new employees.

This major investment will underpin a Sony strategy to develop alliances with Australian third parties to record, manufacture and export audio CDs. In addition, Sony will support title development, undertake local manufacture and export multimedia CDs such as electronic games, CD-ROM, CD-I and electronic book titles. Critically, Sony will provide opportunities for Australian developed and manufactured titles to have access to Sony's global distribution network.

TOSHIBA MARKETS DIGITAL HDTV VCR

Toshiba Corporation has begun marketing the world's first industry use high definition digital video cassette recorder. The company expects it to find wide acceptance among high definition television production and broadcasting companies, and to replace current open reel high definition digital VTR.

The new product results from Toshiba's work to develop high speed, high density

Siemens directors, Eberhard Kill (left) and Klaus Lahr (right), happily sign the Partnership for Development Agreement with Alan Griffith, Minister for Industry, Technology and Regional Development.

SIEMENS SIGNS PARTNER AGREEMENT

Australia's exports will be bolstered by an agreement by the major German telecommunications and electrical engineering corporation, Siemens AG, to use Australia as a base for expanding its presence in the Asia-Pacific region, according to the Minister for Industry, Alan Griffiths.

Mr Griffiths and the Vice President of Siemens AG, from Germany, Mr Eberhard Kill, announced Siemens' commitment to export product and services worth $300 million and to expend $100 million on research and development during the next six years.

The agreement is part of the Commonwealth's Partnerhips for Development program, which encourages international information technology and telecommunications companies to undertake sustainable, strategic activities in Australia which are integrated into the company's international strategy.

"Siemens' investment demonstrates the abilities and international competitiveness of Australia's information technology industry and our engineering sector," Mr Griffiths said.

"In the past decade exports of information technology have risen from negligible levels to more than $1.6 billion each year.

The Partnership agreement will see the establishment of a Synchronous Digital Hierarchy (SDH) Technical Centre, and a Regional Competency Centre for the development of software for telecommunications network management, both with an Asian market focus. The Centres will be located at Siemens' telecommunications and manufacturing facility in Bayswater, Victoria.

These initiatives will generate substantial economic activity for Australia. Siemens has undertaken to invest $50 million in the SDH Technical Centre, which will employ 50 people.

recording technologies, and its cooperation with BTS Broadcast Television Systems of Germany to develop a universal digital high definition recording format.

The new VCR, designed for the Japanese 1125/60/2:1 HDTV video standard, can record up to 64 minutes of high definition digital video and audio data on a 3/4 inch (19mm) metal particle tape, to the same high quality as current one inch open reel high definition video tape recorders.

The new GBR-1000 is priced at 29 million Yen and deliveries are scheduled to start in April.

Wylam Hill Ltd, of West Sussex in the UK, have developed this pocket sized digital ultrasonic thickness gauge which is capable of reading the thickness of metals, plastics and glass to within 0.01mm. The Portagauge can be supplied with a special sensor applicator for measurements on curved surfaces.

APPLE INVESTS IN AUSTRALIAN IT

Apple Computer has announced the first two recipients of investment from the Apple Development Fund, a $10 million fund designed to stimulate information technology developments among Australian companies.

Apple Computer Australia Managing Director David Strong announced that Quidnunc, developer of a software program for dentists, and Matrix, a rapidly expanding company developing and delivering paging and electronic messaging services in Australia and internationally, were to receive the initial investments of the ADF. Matrix represents a $1.85 million investment by the ADF, while the fund has invested $1 million in Quidnunc. The aim of the fund was to help build an internationally viable Australian technology industry, Mr Strong said.

"The Apple Development Fund is providing Australian companies engaged in world-class product development with much needed capital to bring their products to market and enhance these organisations' overall export potential. Traditionally, Australian capital investments have concentrated on conservative opportunities such as real estate and the blue chip end of the share market, and, particularly in the recessionary conditions of recent times, local IT companies have found it virtually impossible to attract

TOSHIBA MAKES 0.04um CMOS GATE

Toshiba researchers in Japan have successfully fabricated a prototype of the world's smallest gate electrode: a 0.04 micron (um) gate electrode N-MOS transistor with 0.01um shallow source and drain junctions. Normal operation of the new transistors at room temperature has been confirmed.

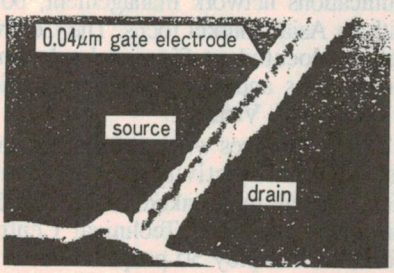
The achievement is expected to be adopted in future generations of high speed, high frequency semiconductors, including 100 gigabit class memories and advanced microprocessors.

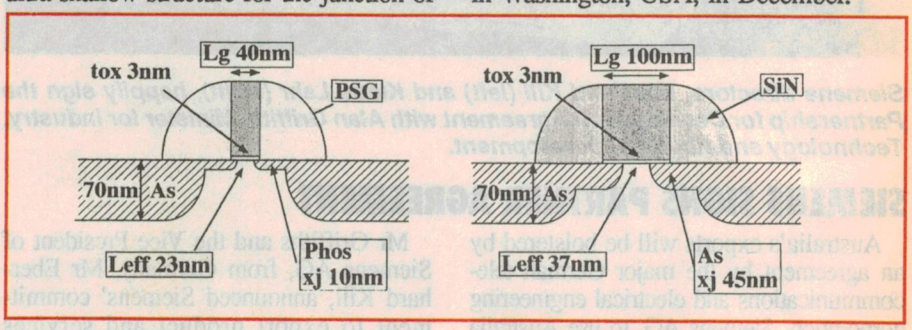
Dr Hiroshi Iwai, Senior Research Scientiest at Toshiba's corporate Research & Development Center, says, "Since the announcement of 0.1um - 0.07um gate length MOS transistors in 1987, there have been no reports of anyone fabricating smaller gate electrode MOS transistors. I understand this is due to technological and physical constraints. Our achievement is a significant breakthrough that carries us beyond 0.1um constraints. We expect to see the results in MOS transistors with gate electrodes of sub-0.1um and under."

The new technologies rest on three key developments:

1. A new design methodology for small geometry MOS transistors, adopting an ultra-shallow structure for the junction of the source and drain (0.001um — 25% of the current minimum), while maintaining conventional values for gate oxide thickness (0.003um) and supply voltage (1.5V).
2. A resist-thinning technology by ashing resists that are patterned with excimer lithography, which enables fabrication of an 0.04um gate electrode.
3. A solid-phase diffusion technology which enables fabrication of ultra shallow 0.01um source and drain junctions.

The details of these achievements were to be presented to the International Electronic Devices Meeting (IEDM), meeting in Washington, USA, in December.





At left is an electron microscope photo of the gate structure. The diagram above shows how the new Toshiba device (left) varies from a conventional N-MOS transistor structure as shown at right.

development capital due to the perceived high risk."

"As a global company, Apple recognises that there are areas of product development excellence that complement our own efforts. Working with companies developing such products will ultimately stimulate the information technology industry into further innovation, creating a significant multiplier effect for further IT capital investment and development."

"We are pleased to announce Quidnunc and Matrix as the initial investments of the ADF. The choice of Quidnunc represents an investment in an Australian company developing software for a unique vertical market application that has very good export potential."

"The Matrix investment is directed towards one and two way messaging for handheld and portable computer devices, such as Personal Digital Assistants like Apple's Newton MessagePad and NoteBook computers. It represents an explosive area in data communication, not just voice messaging and paging. Matrix is also an international organisation, with a large portion of its business already offshore in Asia."

NEWS BRIEFS

- Digital Studio Processing has announced that its range of intelligent digital audio workstations will be exclusively represented throughout Australia by the ***Pro Digital Group*** of Yamaha Music Australia.
- The first ***World Telecommunication Development Conference*** will be held in Buenos Aires, Argentina from 21 to 29 March 1994. For more information contact the International Telecommunication Union, Place des Nations, CH-1211 Geneve, Switzerland; phone +41 22 730 5969, fax 730 5939.
- Geoff Billingsley has replaced Leigh Robinson as Group General Manager of ***Philips Consumer Products;*** while Malcolm McKinlay will take Geoff's old position as General Manager of Philips Components. Craig Quinn's Information Technology business unit has transferred from Philips Components to the Consumer Products Group at Homebush.
- Banksia Technology has appointed Sydney-based ***DPI Systems*** as the primary distributor of its printer enhancement products throughout Australia. It has also appointed ***Merisel Australia*** as a nationwide distributor for its communications products.
- ***Thomas Electronics*** is now the exclusive distributor in Australasia for CRC Components of California USA, which specialises in flyback transformers for the computer repair industry.
- ***Innovative Sound & Media Technologies***, an Apple Computer specialist reseller and distributor for Digidesign audio recording products, has opened a branch office in Brisbane. Its address is 10 Evans Street, Bowen Hills 4006; phone/fax (07) 252 1274.
- ***Independent Information Technology Training*** will hold several PC Troubleshooting Courses in 1994. These are in Sydney from 23-25 February and 25-27 May; and in Melbourne from 14-16 February and 18-20 May. For more information contact IIT, 35 Pitt Street, Sydney 2000; phone (02) 252 2844.
- Robert Costello is the new Sales and Marketing Manager of ***Scan Audio***, the Melbourne-based loudspeaker company.
- ***Nilsen Instruments*** has been appointed the Australian distributor for Nishizawa's range of Test and Measuring instruments.
- ***GME Electrophone*** will distribute and support the Californian Interphase Technologies' range of echo sounders, plotters and GPS products.
- ***Samsung Electronics Australia*** has appointed Mr Eric Krieger as its National Sales Manager, Information Systems Division. ❖

UPS OFFERS FASTER IMPORTS

Electronic importers can expect lower import costs and faster deliveries following the introduction of a new express service which uses high tech tracking and EDI systems.

Recently introduced to Australia by worldwide parcel distribution company United Parcel Service (UPS), the service is specifically designed for importers of small shipments requiring flexibility.

According to UPS's local managing director, Mr Rocky Wood, most importers of electronics components do not realise that in 90% of cases it is cheaper to use express delivery services, especially for shipments under 30 kilos.

"At least 95% of businesses currently using freight forwarding services could improve their cash flow and customer services by importing smaller quantities more frequently. Previously this was not a cost effective option," he said.

He said original equipment manufacturers (OEMs) and electronics distributors traditionally imported materials in bulk quantities in the belief they were achieving economy of scale. "However, this can be an expensive practice if you add storage costs, shrinkage, interest, additional delivery charges and the costs of outdated or redundant material."

"UPS makes use of $1.8 billion worth of computer hardware and software to track parcels worldwide. Also, customs information is automatically transmitted enroute to a parcel's destination."

Further information is available from UPS on (02) 667 1333.

SOLAR ENERGY CENTRE FOR WA

The world's first Centre for Applications of Solar Energy (CASE) is being established at Perth by UNIDO, (the United Nations Industrial Development Organisation), the Federal Government and the Government of Western Australia. Other such centres are expected to be set up elsewhere in the world.

The CASE concept provides for centres which do not duplicate the activities of existing research institutions or business enterprises. The centres will generally not undertake basic research or engaged in manufacturing activities. Rather, they will:

- promote applications for, and commercialisation of, solar energy technologies in developing countries;
- assemble a cohesive team of individuals, highly skilled in the areas of engineering, international finance, marketing, sociology and scientific research;
- establish and maintain links with organisations involved in research, development, finance, manufacturing, distribution and international trade;
- support the establishment of other Centres for Applications of Solar Energy and maintain communication and interaction with these centres as they are established to form a cooperative network;
- become self-funding without compromising a position of impartiality or professional integrity; and
- respond to the requirements of developing countries for energy-related professional services.

Market evaluation has been given high priority in the initial work programme of the Perth CASE. One aim of this activity is to identify, through consultation with developing countries — particularly in the Asia-Pacific region — energy service needs which are able to be satisfied by solar energy technologies.

These needs, often shared by many developing countries, include, but are not restricted to, services such as: remote area power; water pumping; vaccine refrigeration; water purification and distillation; industrial process and domestic water heating; crop and timber drying; and domestic cooking. The Perth work programme will be extended later to include other activities in response to demand from developing countries.

Infrastructure funds for the Perth CASE are being met by a State Government grant of A$500,000 annually for five years, with matching grants from the Federal Government. Murdoch University has offered land in its science park for a permanent Centre. In the meantime, CASE will operate from temporary facilities at the University. ❖

Las Vegas displays the latest computer technology:

MULTIMEDIA, WIRELESS DATA STAR AT COMDEX

Multimedia systems and wireless data transfer were the main stars at the latest Comdex show, according to our correspondent Paul Swart. Apparently the battle of the 'next generation' processor chips is also starting to heat up, with Intel mounting a big push for its Pentium architecture while the Motorola/IBM/Apple camp cranks up the promotion for its RISC-based PowerPC chips...

by PAUL SWART

A record 170,000 co mputer industry professionals descended on Las Vegas late last year for the annual Comdex show. With slowing demand for PC's hanging as a dark cloud over the otherwise clear desert skies, the main focus at the show was on new directions in the use of PCs — which could extend the two year boom in PC sales. More than 2000 companies exhibited at this year's show, which was spread out over six locations throughout the city.

Last year's Comdex was different from past shows in that the driving questions in the industry are no longer whether to buy a Compaq or IBM or Dell PC, but which operating software and microprocessor platform retailers and systems houses should be considering. Intel, AMD, MIPS, and Motorola turned Comdex into a battleground for pushing their respective microprocessor architecture as the best platform to take computer users into the next century.

Intel had show-goers lined up all through the show to see a multi-media production called 'The Adventure Inside', which showed the power of its Pentium processor. Across from the main convention hall, Motorola, in cooperation with IBM and Apple, operated a large tent in which each demonstrated the power of the PowerPC, including head-on performance tests between Pentium and PowerPC-driven PCs. In each case, the PowerPC machines completed their often complex graphics-oriented tasks in a fraction of the time it took Pentium machines.

Multimedia goes mainstream

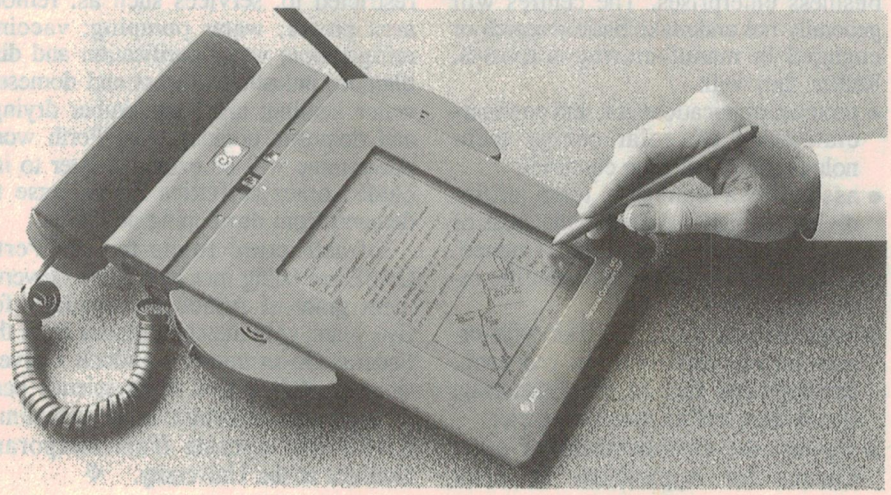
Chief among the new soon-to-be mainstream technologies in personal computing was multimedia, for which Comdex dedicated an entire exhibit hall.

Still in its infancy, but clearly also moving to the forefront is wireless communications, and the ability of users to quickly and easily send and receive e-mail, faxes, and other data on a laptop, palmtop, or PDA-type computer. At times it seems everyone was sporting some sort of antenna, as a number of firms allowed show-goers to try out existing or prototype of their wireless communications products for a few days.

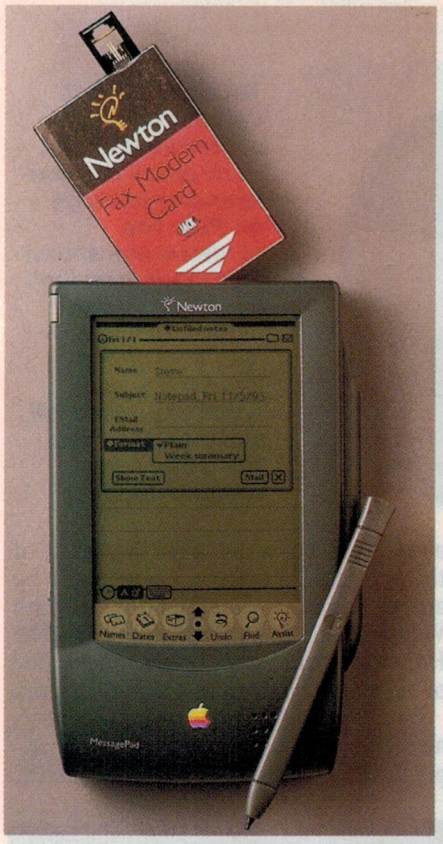
VoiceMail of San Mateo, for example, provided several hundred journalists with its radio based modems, which plug into the communications port of most laptops. VoiceMail allows anyone whose office computers are connected to the Internet network to send and receive e-mail, fax and other data.

"Wireless communications is here now," boasted VoiceMail's public relations agent Bill Orrange. VoiceMail charges $89 a month for unlimited use of the service.

Other companies showed new credit card-size communications cards which plug into the memory card slot on many new PDA's. Apple showed its card for



AT&T/EO displayed its EO440 personal communicators, which come with an optional cellular telephone modem for wireless communications. The units are being promoted as the first to integrate a complete set of messaging capabilities into a compact portable pen-based device.



Apple computer displayed a PCMCIA fax/modem card for the Newton PDA.

the Newton allowing the PDA to receive news articles, send or receive electronic mail and connect the Newton to computer networks.

Spindler makes a vow

Although the phrase 'price war' was used by most speakers in a past tense content, there were plenty of signals that the industry may face new rounds of price cuts in 1994 — spearheaded by plummeting prices of Pentium-based computers. Already Pentium computers have seen price drops of 25 - 40% in the past two months. As Pentium machines come down further in price they are likely to put additional pressures on mainstream 486 computers to follow suit.

In his keynote address, Apple president and chief executive officer Michael Spindler vowed that Apple would drop its traditional strategy of asking users to pay a premium for the company's superior technology.

"As an industry leader in technology, we will not price technology too high. Never Again! Never before in any industry has the technology leader also been a price/performance leader. While the industry trend is often to reduce research and innovation to provide lower prices, we intend to maintain our innovation while increasing performance and keeping prices low."

"Our mission is to do more, cost less, fit in, and stand out. Our most important operating principal will be to be customer-driven. We have to make things people can use. You can talk just so much about long term industry trends. Sooner or later you have to focus on the near-term customer needs."

Spindler said Apple is in a good position to make good on its promise. With the cost of PowerPC processors at only a third of Intel's Pentium chips, Spindler is confident that Apple will be able to gain a performance edge over the IBM-PC industry while remaining price competitive at the same time.

Gates pushes NT

Besides Spindler, Microsoft chief Bill Gates and Sun Microsystems president Scott McNealy were among the main speakers. Unlike some of his past presentations at Comdex, Gates disappointed the packed ballroom. After a few general statements such as "This still has a long way to go to make information easy to use," Gates' presentations quickly turned into a promo/demo for 'Microsoft at Work' and Microsoft NT including demonstrations by a number of users who have implemented these new products in their company's new operations.

Gates rebuffed industry critics, who have said NT is slow getting out of the starting gates. Gates said Microsoft studies are showing that 40% of serve users plan to switch to NT in the near future. "Microsoft has never been used to seeing such fast acceptance of its operating systems."

McNealy blasts Microsoft

Boring was the last thing that could be said of the speech delivered by Sun's McNealy, who appeared to have come to Las Vegas with a vision of converting millions of PC users into workstation followers. McNealy sharply attacked Microsoft's proprietary operating system strategy, and stopped just short of calling for an industry revolt against Microsoft.

"If I owned the English language and you had to pay a $240 license fee with every upgrade, you would scream. People don't want to keep paying taxes to a little company in Washington."

McNealy said the future is in open systems, and challenged PC users to take a serious look at Sun's Solaris operating system. "With its 'WABI' (Windows Application Binary Interface) users can not only run Windows applications, but they will be able to run them a lot faster on Sun's RISC workstations."

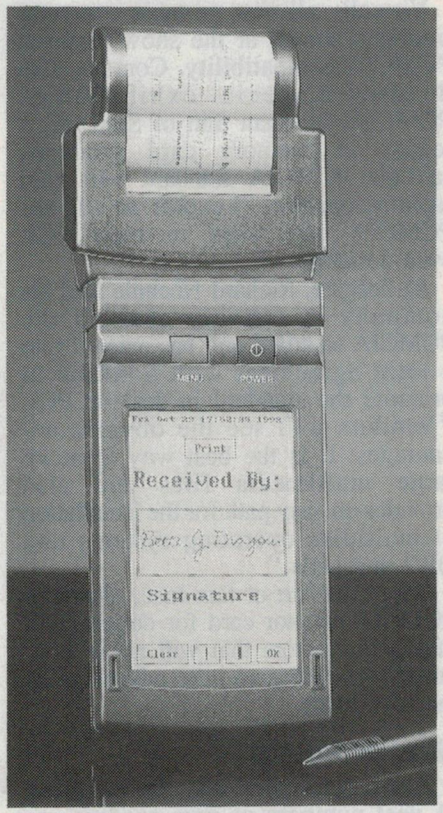
"The myth is that RISC is faster than CISC. Wrong! RISC is way lots faster." McNealy conceded that the first version of WABI is not yet sufficient for power users, but improved versions are on the way. "We expect you to give us the same breaks you gave Microsoft's Windows 1.0, 2.0, 3.0, and 3.1."

PCI bus and PCMCIA

Two new technologies that gained considerable attention at this Comdex were the PCI bus and the PCMCIA memory card standard.

"PCI is really happening and this Comdex is the coming out party," said Bruce Stephen, a computer industry analyst with International Data.

PCI which was developed by Intel, is being offered on a royalty-free basis to systems developers in an effort to quickly turn the local bus into the next industry standard, replacing today's ISA bus. The PCI bus was developed to specifically enable personal computers to deal with the vast amounts of data being moved around inside a system which performs high-end



Epson also released a PDA device, the MS-DOS based EHT-30. This features a PCMCIA Type II card slot, signature capture and a wide range of options including character recognition.

Multimedia, wireless data star at Comdex

graphics, communications, and multimedia applications.

PCI backers believe the bus will gain rapid acceptance because of its obvious speed advantages while maintaining backward compatibility. In addition, PCI buses can be implemented in a single chip, something that is very difficult with ISA/EISA or Microchannel buses.

At the PCI centre at Comdex, promoters predicted that the first wave of PCI-based products will also feature slots for multiple buses. A typical eight-slot system will have three PCI slots, four EISA/ISA slots and one that can go either way.

Meanwhile, while it may take several more years before even most industry insiders understand what PCMCIA stands for (Personal Computer Memory Card International Association), they will appreciate the improvement in products that incorporate the standard. This will eventually allow people to use a single memory card and insert it in a broad variety of machines — including digital cameras, fax machines, copiers, and desktop and portable computers and PDAs.

Virtually all new portable computer products shown at the show featured PCMCIA compatibility. Comdex also devoted a special exhibition of PCMCIA. Norman Sun of SunDisk, a leader in memory card products, said the PCMCIA standard will gain rapid acceptance. "I expect we will see PCMCIA card slots in most PCs, even desktops.

At Seagate, Richard Hoehnle said his company is actively pushing the PCMCIA standard and has entered into a joint agreement with SunDisk to promote the standard in desktop PCs. "Vendors will see the obvious advantages. It is the best way to move large multimedia files and also provides an easy path for the installation of multidisk operating systems like OS/2 and Unix."

One, CardPort of San Jose, showed a PCMCIA adaptor card for desktop and laptop computers that will allow even current machines to take advantage of memory cards.

New products

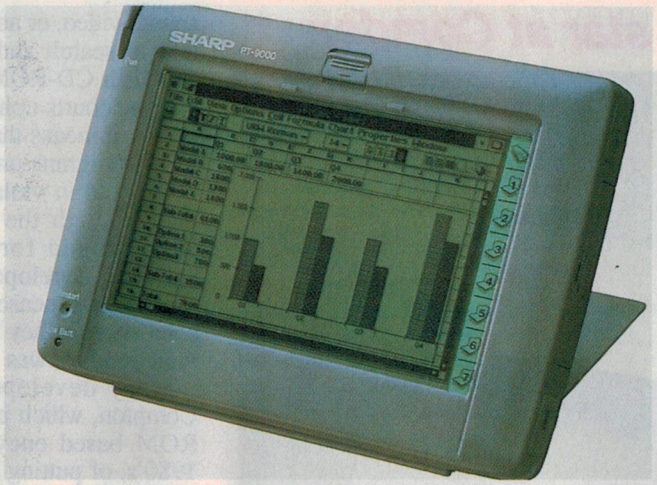
As usual Comdex was also the scene of vast numbers of new product announcements. A local Las Vegas newspaper put a copy of every press package in the press room on a scale, which showed a whopping 521 pounds of material. Among the major product announcements was Apple Computer, which demonstrated the 'Houdini,' a Macintosh that also incorporates a 486-based Windows PC. A special 'Houdini' chip allows users to switch between Mac and PC applications, without having to turn off their system.

The computer which will retail for about US$500 more than the price of the standard Performa 650, will be aimed at users who operate on both Windows and Macintosh platforms. The Houdini would enable them to take one of their two computers off the desktop.

Industry analysts said the machine is mostly a gimmick as most major applications are already available on PC

Twincom of North Carolina demonstrated its C-Phone, a low cost video conferencing package for PCs. The hardware unit shown here mounts on the top of your video monitor, while a plug-in card and Windows based software provide full motion, full screen video with audio communications.

Toshiba released its new T-3400 'ultra-portable' computer, christened the 'Portege'. (A mis-spelling, maybe?) The unit features a 33MHz 486 CPU, an active matrix colour display and a VL Windows graphics accelerated bus.



Sharp displayed its new PT-9000 personal information assistant, which will allow users to hook into Motorola's EMBARC wireless messaging network. This will enable it to receive multipage text messages, e-mail, and database updates.

and Apple platforms. and most Macs can already read IBM files.

After getting under way earlier last year, small mobile computers such as PDAs were seen at many Comdex booths. Apple put on a big display for its Newton and introduced a US$165 upgrade kit which will enable Newton users to interface with Windows-based PCs. The Newton's incompatibility with the 50 million-user PC market was one of the key points of criticism Apple has encountered since it launched the product.

Epson introduced an MS-DOS based PDA called the EHT-30 featuring a touch screen LCD display, and a new lithium-ion battery which gives the machine 14 hours of continuous use. Users can install an optional handwriting recognition software package that includes the CIC PenDOS operating system. Pricing was not made available.

Full motion, full screen PC-based video teleconferencing is now easily and cheaply possible thanks to the C-Phone (announced by Twincom of North Carolina. The PC to PC video teleconferencing systems sits atop a PC monitor connected to a local area network.

"Existing teleconferencing systems require users to leave their offices and computers to make a video conference call, and they only transmit images. Our technology allows people to make television-quality video calls from their desktop PCs to other people on the network, or to remote locations over high speed phone lines," said Twincom chairman Daniel Flohr.

The C-Phone requires a Windows based computer and works with either Novell's Network management software or Artisoft's Lantastic software. Up to 64 simultaneous video calls can be made over the network. The product was expected to become available in December, but no pricing was announced.

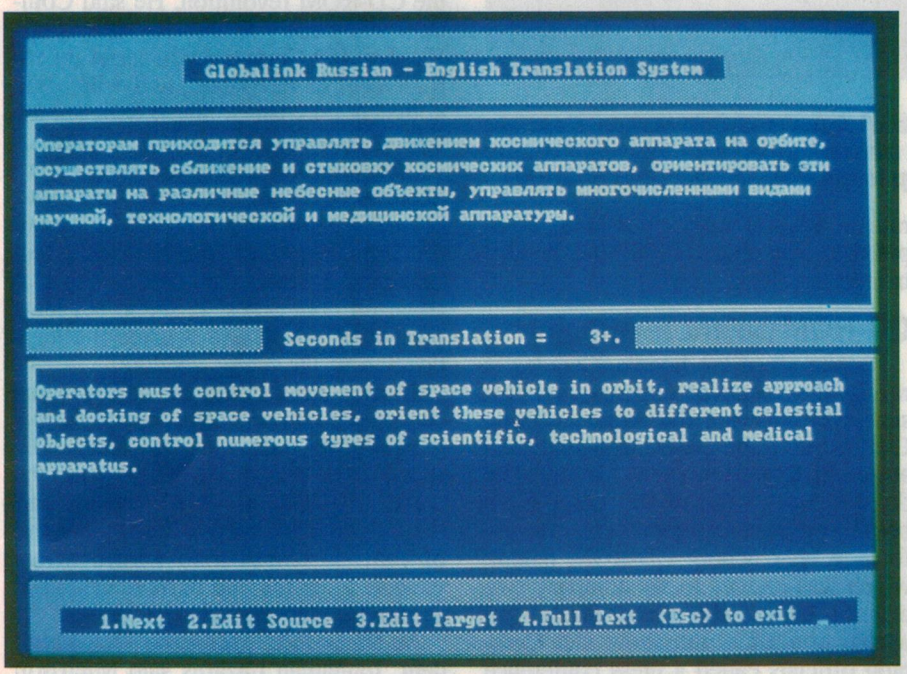
The C-Phone's software essentially turns the PC into a telephone, including such features as 'call waiting' and 'caller ID'. It will also enable the user to send a video message to any number of users on the network. More than two people can take part in the video call.

VRex, of Hawthirne, New York, introduced the 'CyberBook', claimed to be the industry's first notebook PC designed specifically for multimedia, virtual reality and 3D-TV use. A key feature of the system is its 3D stereographic display. The machine also features so-called 'SMUX' software that allows users to quickly and easily create three dimensional images using standard Windows-based graphics and design application programs.

The CyberBook will sell for US$3900 including the SMUX program.

Toshiba announced the Portege T3400, a new 'ultra-portable' computer featuring a number of industry first features, including the first active matrix display and VL Windows graphics accelerating bus in a sub-notebook machine. The Machine is built around a 33MHz 486. The Portege's base price starts at US$2599.

Sharp also showed off a new PDA at Comdex. The so-called PT-9000 Personal Information Assistant was to be launched early in 1994. Sharp said it has reached an agreement with Motorola that will enable users of the PT-9000 to hook into Motorola's EMBARC wireless messaging network. That means the PT-9000 will be able to receive multipage text messages, electronic mail, database updates, and a range of information services on their machine.



Globalink of Fairfax, Virginia made quite a splash with its PC based language translation programs, for both IBM compatibles and Macs. The company claims to achieve 90% verbal and grammatical accuracy at up to 20,000 words per hour.

Translation software

Globalink of Fairfax, Virgininia made quite a splash at Comdex with a series of PC based to-and-from English language translation programs, including French, German, Spanish and even Russia.

Both PC and Macintosh users can scan a piece of foreign text into their PC and have the program translate it to English or the other way around.

Globalink claims the translations are

Multimedia, wireless star at Comdex

Motorola released two PCMCIA 'NewsCard' Advanced Information Receiver cards for the Apple Newton, to provide it with enhanced data communications facilities — including the ability to hook up to the EMBARC wireless network.

90% verbally and grammatically correct — enough for anyone to edit the translated material into a perfectly translated document.

"They said it couldn't be done. Government, academia, and the corporate community have tried for decades to develop accurate translation programs," said Globalink president William Greogry.

"In many respects, language represents the final hurdle to the globalisation of business and societies. Our technology makes it easy for everyone to clear that hurdle."

Globalink software translates entire sentences instead of the word-by-word translations offered by competing products. The company claims users will be able to translate material at the rate of 20,000 words per hour, compared to only about 600 for the average human translator.

CD-ROM patent revolt

Despite all of the hoopla, Comdex is rarely the scene of controversy. But scores of software developers visiting Comdex used the occasion to vent their anger at Compton New Media. The developers swarmed the company's booth to protest Compton's plans to enforce a far-reaching CD-ROM patent, which was granted to the company two months before the show. Such an uproar erupted at the show that Compton officials called a press conference to explain the firm's point of view.

The patent involved covers any software program that uses graphics, sound, video, or anything else other than text to search and retrieve information stored in CD-ROM based databases.

If the courts uphold the validity of the patent, it means that virtually every CD-ROM program on the market today is being sold in violation of the patent — even though the products may have been around for years. Potentially, software developers are facing penalties, legal expense, and future royalties even though they probably never knew their product was violating the patent.

Many developers angrily accused Compton, which produced the first CD-ROM based encyclopedia in the late 1980's, of putting up a roadblock which would slow down the development of CD-ROM as the new industry standard for software and data storage.

"If Compton succeeds in stifling people, it will hurt the most critical part of the industry right now: search and retrieval, which neither computers or television do well," said Nick Arnett, president of Multimedia Computing of San Jose.

Compton executives stood by their rights at the press conference, saying the company was the forefather of multimedia, and it is only getting what it rightfully deserves for having kick-started the multimedia market in the 1980s.

"The whole industry has profited from our investment," said Compton president Stanley Frank, adding that his firm has no desire to slow the spread of the CD-ROM revolution. He said Compton will widely license its technology. He also said Compton will insist on enforcement of the patent, and will begin notifying companies that it believes are selling products that violate its patent.

Chief among Compton targets are likely to be Microsoft, Apple, and IBM, all of which sell CD-ROM based products. However, the company will first pick a number of fights with less powerful companies, to try to set legal precedents which will weaken the legal position of the major vendors.

Stanley Frank said he believes the company's patent reached much further than simple data retrieval from CD-ROM disks. It may extend way into the world of the data super-highway, particularly the interactive television part of that — which also would allow viewers to search and retrieve data such as movies and television programs.

At Microsoft, executive vice president, Johnathan Lazarus said Microsoft would probably fight Compton's patent claims. "It is often easier to obtain a patent than to enforce it." ❖

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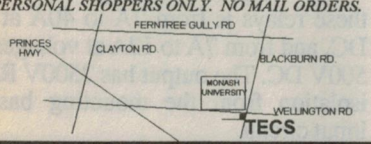

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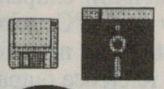

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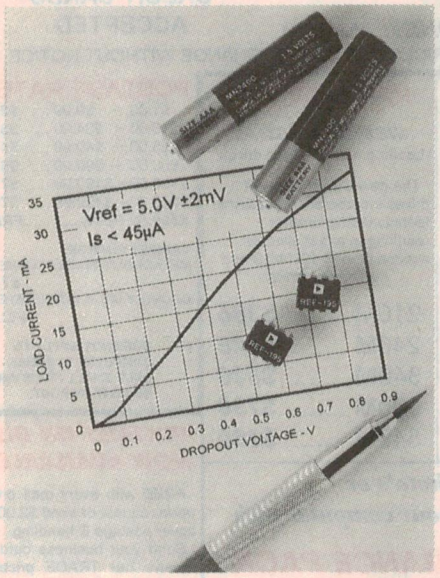


Analog Devices' REF-195 is a micropower, low dropout +5V voltage reference, requiring only 45uA supply current.. Offering an initial accuracy of +/-2mV and able to source up to 30mA, the REF-195 acts as both a precision voltage reference and a highly efficient voltage regulator in a variety of battery powered systems. Applications include industrial process control, portable instruments, remote data acquisition and panel meters.

Using a patented temperature compensation circuit, the REF-195 offers a high initial accuracy with a low temperature coefficient of only 5ppm/°C, minimising or even eliminating the need for costly calibration of the reference output. The reference is also a low dropout voltage (LDV) device which provides a stable +5V output from a variable supply as low as +5.10V.

In battery powered designs, this low dropout feature can significantly extend the useful operating time between battery charges, even when the battery output begins to droop. A shutdown feature further reduces power dissipation to less than 15uA.

Unlike other LDV references which require bulky 100uF capacitors to retain output accuracy, the REF-195 operates from a 1uF capacitor and is able to drive capacitive loads larger than 100uF.

The REF-195 is also an efficient voltage regulator. Supplying up to 30mA, the load and the line regulation are typically 2ppm/mA (4ppm/mA max), and 4ppm/V, respectively. The output of the REF-195 is also fully protected from short circuits.

For more information circle 271 on the reader service coupon or contact NSD Australia, Locked Bag 9, Box Hill 3128; phone (03) 890 0970.

Solid state relay

Crydom series-1 DC solid state relays incorporate power MOSFETS as output devices in a convenient package. These DC relays take full advantage of the power efficient, low-on resistance of MOSFETS, together with their established features, such as freedom from secondary breakdown, fast switching, ease of paralleling, temperature stability and high reliability.

The output switching capability of these relays is from 7A to 40A at 100V DC, and from 7A to 12A at voltages up to 500V DC. The output has 2500V RMS of isolation from the mounting base and input circuit.

The input can be driven from most logic circuits, requiring less than 1.6mA at 5V DC. The control input range is from 3.5V to 32V DC.

Relays can be purchased as individual modules or as complete assemblies, including heatsink, semiconductor protection fuse and suppression diode.

For further information circle 273 on the reader service coupon or contact Fastron Technologies, PO Box 1212,

Low cost Hall switches

Siemens has released two new Hall switches, TLE 4905 and 4035. Their main areas of application are the electrical commutation of brushless DC motors, position detecting (e.g., of gear settings), flow measurements, rotational speed measurements, or use as non-contact limit switches. Sensor systems which satisfy the requirements of DIN 40839, Parts 1 and 4, can be constructed with simple components.

Both ICs are magnetically actuated electronic switches; they contain onchip the actual Hall generator, an amplifier with Schmitt trigger, an internal stabilised power supply, as well as reverse voltage protection.

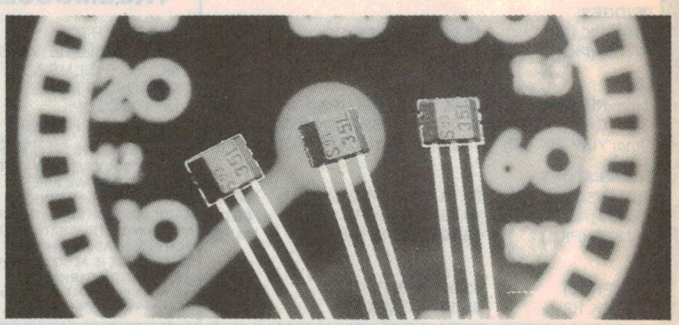
When a magnetic field acts perpendicular to the chip surface, it generates a voltage at the probe terminals of the Hall generator. This is amplified and fed to the Schmitt trigger, which in turn, drives an open-collector transistor. If the induced voltage exceeds the switch-on level, the transistor is turned on — it switches.

The TLE 4905 is a single pole switch and reacts only to the magnetic south pole. It is particularly suitable for use as a limit switch.

The TLE 4935 is a two pole switch which conducts when a 'south pole' is applied and is blocked again by a 'north pole' of equal strength. Without a field it always remains in the last state ('latch'). Its field of use lies in all applications with rotors.

Both devices have interference immunity class five. They were subjected to various field strengths in an electromagnetic field at frequencies in the range between 100kHz and 750MHz (up to 100V/m with an additional 1kHz amplitude modulation; up to 200V/m without AM), and no switching errors could be observed under these conditions. The same applies also to the minimum operating voltage or to two wire operation.

For further information circle 272 on the reader service coupon or contact Siemens Advanced Information Products, 54 Church Street, Richmond 3121; phone (03) 420 7345, fax 420 7275.



Dandenong 3175; phone (03) 794 5566, fax 794 6670.

New 3.3V Intel486

Intel Australia has announced the 3.3V 50MHz Intel486 DX2 microprocessor. This SL enhanced processor is the highest performance Intel486 microprocessor available at 3.3V, enabling high performance, low power notebook computers. Now the performance of the Intel DX2 microprocessor is available for mainstream notebook computers.

The 3.3V microprocessor offers twice the processor performance, yet consumes less than half the power of the 5V Intel486 DX microprocessor, at a comparable system price. At 3.3V it typically consumes just 1.5W.

The new 50MHz Intel DX2 microprocessor is pin compatible with the rest of the Intel486 DX and DX2 microprocessor families, ensuring ease-of-design and fast time-to-market for system manufacturers. Packaged in a small 208-lead SQFP package, it requires 30% less motherboard area and 40% less volume than the Intel486 DX microprocessor PQFP (plastic quad flatpack) package.

For further information circle 276 on the reader service coupon or contact Intel Australia, PO Box 1486, Dee Why 2099; phone (02) 975 3300.

Precision amplifier

Burr-Brown's INA115 is a new, general purpose instrumentation amplifier that combines excellent accuracy with versatility. Similar to the popular INA114, a precision and low cost IA, INA115 offers additional connections for programmable gain and shield drive applications. Its three op-amp design and small size also make it ideal for a variety of applications including bridge, thermocouple and RTD sensor signal conditioning; laboratory, analytical, and data acquisition; and medical instrumentation.

Gain is set with a single external resistor. Connections to the inverting inputs of the input op-amps allow an external multiplexer to accurately select various gains. Outputs of the input op-amps are useful for shield drive applications.

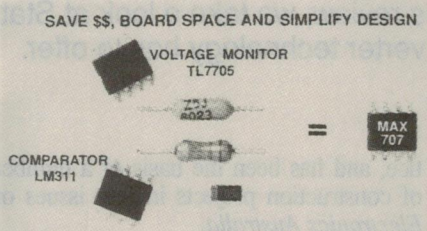
Low offset (50uV) and drift (0.25uV°C) eliminate external trimming. Input bias current is 2nA (max) and common-mode rejection is 115dB. Operation extends from +/-2.25V to +/-18V on a mere 3mA (max) — ideal for battery or single 5V supply systems. Inputs are internally protected to +/-40V, even with power supplies off.

For further information circle 277 on the reader service coupon or contact Kenelec, 2 Apollo Court, Blackburn 3130; phone (03) 878 2700, fax 878 0824.

Supervisor ICs

Maxim's MAX705-MAX708 devices are microprocessor-supervisory ICs which issue resets or other warnings on detection of a malfunction in the uP's power supply or program execution.

The devices are ideal for 3V portable applications as well as traditional 5V designs. Their compact eight-pin DIP and SO packages save space, and by operating with no external components or clock signals they further simplify circuit design and layout.



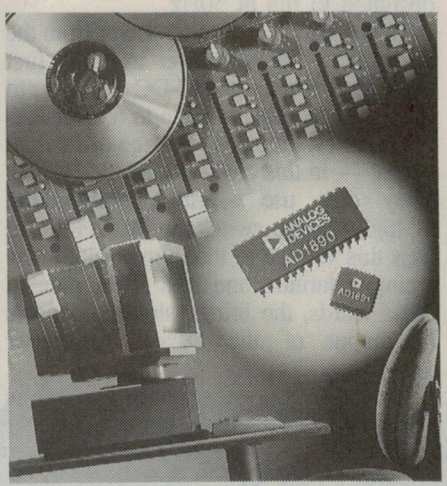
The products differ in the functions offered and in the trip thresholds built into their Vcc-monitor circuits: the MAX706 and MAX707 have 4.65V thresholds (for 5V +/-5% supplies), while the MAX706 and MAX708 have 4.4V thresholds.

Three-volt versions of the MAX706 and MAX708 (designated with P, R, S, and T suffixes) provide thresholds of 2.6V, 2.93V and 3.08V. Each IC issues a reset when VCC drops below its threshold, i.e., for all conditions of power-up, power-down, brownout, and momentary power interruption. RESET assertion is guaranteed for Vcc as low as 1V. All devices have a debounced manual-reset input (MR), which lets you generate reset pulses on command (200ms typical, 140ms minimum).

For further information circle 275 on the reader service coupon or contact Veltek, 18 Harker Street, Burwood 3125; phone (03) 808 7511.

Stereo asynchronous 'Sample port'

Analog Devices' AD1890 and AD1891 SamplePort stereo, asynchronous sample-rate converters solve sample rate and digital data interconnect problems in professional, computer communications, and consumer audio applications.



The AD1890 and AD1891 are fixed-function, DSP-based ICs used to convert a digital input sample stream — at an arbitrarily clocked or dynamically changing sample rate — to a user-set output sample rate. Input and output clock frequency is automatically sensed with no user programming required.

Computer communications applications, such as multimedia and networked audio systems, will benefit when the AD1891 is used. Incompatible digital audio consumer equipment, including MiniDisc units, CD and DCC players, HDTV and digital loud-speakers can now interface — just like the old analogdays.

The AD1890 is tailored for professional audio designs accepting input sample widths up to 20 bits, while the AD1891, intended for consumer use and computer communications, accepts sample widths up to 16 bits and offers slightly reduced functionality.

For further information circle 278 on the reader service coupon or contact NSD Australia, Locked Bag 9, Box Hill 3128; phone (03) 890 0970. ❖

Product review:

Statpower's hi-tech DC-AC inverters

Featuring advanced switchmode circuitry, these portable 12VDC to 240VAC inverters are compact, lightweight and very rugged. In this review, we take a look at Statpower's 200VA and 800VA models to see what the leading edge of inverter technology has to offer.

by ROB EVANS

There's no doubt that battery-powered inverters are becoming an increasingly popular method for generating a 240V AC supply where mains power is inaccessible. Whether it's camping, boating, farming, general construction work or wherever an independent source of mains power is needed, chances are that there's an inverter available to suit the job. While engine-driven generators are really needed for higher power applications (say, greater than a kilowatt), the current generation of electronic inverters is ideally suited to low-powered and medium-powered applications in terms of noise, pollution, size and weight.

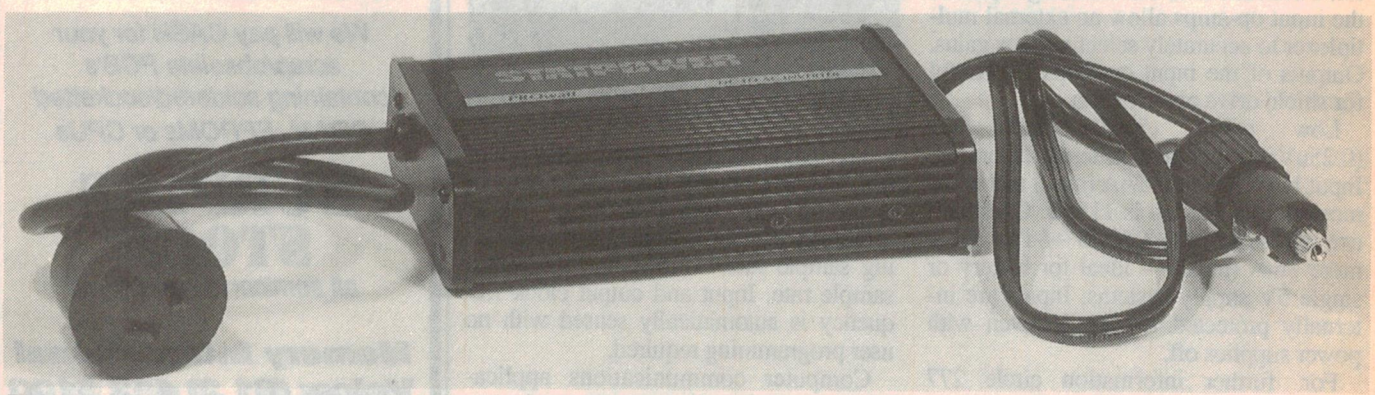
To produce mains power from a 12V DC source, a typical inverter circuit uses higher power MOSFET devices to switch this voltage through the primary winding of a purpose-built inverter transformer (usually a toroid), at a 50Hz rate. Put simply, this AC energy is then stepped up to a 240V level in the transformer's secondary winding by virtue of an appropriate turns ratio, and the final output voltage controlled by the use of feedback circuitry. With an efficiency figure of around 90%, this type of square-wave inverter circuit works very well in practice, and has been the basis of a number of construction projects in past issues of *Electronics Australia*.

In order to reduce both the size and weight of their 'PROwatt' range of inverters however, Statpower has taken an innovative new approach to the power conversion circuitry by employing *high-frequency* switching techniques, such as those normally found in computer switchmode power supplies. The big advantage here is that this type of circuitry can use very small and lightweight conversion/isolating transformers, whereas the more traditional arrangement mentioned above must use a comparatively bulky transformer designed to run at 50Hz.

To produce 50Hz mains power from the DC source, the Statpower inverters first use a high-frequency DC-DC converter to raise the incoming voltage to a level corresponding to the *peak* voltage of its final output — in this case, around 265V DC. They then use a bridge configuration of high-voltage switching MOSFETs, to pass this voltage to the output with alternating polarities, and at a 50Hz rate. In other words, the bridge simply connects the output of the DC-DC converter between the Active and Neutral connections for an output of +265V (the positive 'mains' swing), then reverses this connection for an output of -265V (the negative mains swing).

Note that while this cycle continues at a 50Hz rate as you would expect, the actual width of each pulse is somewhat less than the 10ms period allocated to a mains half-cycle. For a few milliseconds between each alternate pulse, the output is held at zero. This type of 'modified sine wave' output is common amongst power inverters, and provides a better approximation of the mains waveshape than would be the case if a true squarewave was used. With the waveform used in the Statpower inverters by the way, a peak level of 265V corresponds to a mains output of 230V *RMS*.

The most obvious evidence of the success of Statpower's novel design approach is the physical properties of the inverters themselves — since to put it bluntly, they are a fraction of the size and weight of conventional inverters with similar ratings. And as you can see from the associated photographs of the smaller 200i model and the more elaborate 800i, the



Despite its small size and simple appearance, Statpower's PROwatt 200i produces 200 watts of AC power and uses quite sophisticated circuitry.

designers have taken full advantage of the small circuitry by using neat low-profile cases for both units. These are based on extruded aluminium sections, which also act as heatsinks for the circuit's MOSFET switching devices.

The 200i and 800i

With a 200VA rating, the Statpower 200i is aimed squarely at applications where a highly portable but moderately-powered inverter is needed, such as camping and boating — it can be used to power a range of appliances such as TVs, computers, small power tools, and so on. This image is further enhanced by its cigarette lighter style 12V DC connector, and the lack of any warning lights, readouts or user controls. All in all, it's a no-frills unit intended as a simple and quick solution for basic inverter jobs.

It's not short on sophisticated protection circuitry however, and despite its simple operation and appearance the 200i will shut itself down in response to a number of 'error' conditions. Specifically, it will turn off (or reduce) the 230V output if the unit is overheated, overloaded, or the battery voltage drops below a 'safe' level where there may be insufficient energy to start a vehicle's engine — there is an advanced warning of this however, as an audible alarm sounds if the source voltage drops below about 10.7V.

Physically, the 200i weighs in at just 570g and has external dimensions of 40 x 110 x 155mm, so it would easily fit into a car's glove box or a small storage compartment in a boat. So all in all, it's a very neat little unit which should be a quick and simple solution to moderate power needs in a mobile situation.

With an all-up weight of just 2.3kg and external dimensions of 75 x 240 x 260mm, the larger 800i model is also very compact for its 800VA rating — again, an equivalently-rated unit using a conventional transformer would be considerably larger and heavier.

It shares the same style of extruded case/heatsink as the 200i, but in line with its more up-market image, it also offers a number of front panel readouts to indicate the inverter's current status.

As you can see from the photos, besides the expected 230V AC outlet socket, the 800i's front panel contains two bar-graph LED meters which show the DC input current and voltage, LED indicators to alert the user of an output overload or excessive case temperature, and a single on/off switch. Its rear panel holds a set of very large screw terminals for the 12V DC inlet, and also a grille-covered air inlet for the unit's internal cooling fan.

The 800i also offers the same elaborate protection circuitry as the 200i, plus an overvoltage function which shuts the inverter down if the input voltage *exceeds* what it considers to be a safe limit — about 15V for this unit. Both this almost bomb-proof protection and its high power capabilities make the 800i ideal for semi-permanent installations, such as larger boats and caravans, mobile workshops, service vehicles and so on. This seems to be what the designers of the 800i have in mind as well, since as you can see from the photograph of that unit, the bottom panel has extended side flanges with appropriate holes for mounting bolts.

On the bench

We tested the inverters under a variety of load conditions, using a single 12V car battery as a source, and measuring the mains output levels with an RMS-reading voltmeter as recommended in Statpower's supplied literature. Measuring the high levels of DC input current (in the tens of amps) proved to be a little awkward however, and we eventually settled on simply reading the voltage drop across one of the input cables, where the voltage-to-current relationship (that is, the cable resistance) was first determined at a lower input current — at *only* 12 amps!

Despite its almost pocket-sized appearance, the 200i delivered an impressive performance, and produced its rated power with good regulation and efficiency. For a no-load output voltage of 238V RMS this only dropped to 231V RMS for a 208W load, and the efficiency was calculated at 89%. These figures improved at lower load currents, where the output was 236V RMS at 95W with an efficiency of 91%, and 238V RMS for 60W at 93% efficiency.

We then checked the 200i's conduct when driving a number of 'real world' loads, which would be typically used with this type of inverter — these included an IBM-compatible computer, a small hifi system, a television receiver and a hand-held power drill. All appliances performed as expected, with no sign of interference in the computer, hifi or television (even when tuned to a weak signal), and plenty of torque available from the power drill.

During these tests we also checked the unit's output frequency, and its ability to cope with a short-term overload. It also performed well here, showing an output frequency which was consistently within 0.1Hz of 50Hz, and an ability to deliver a 'surge' power of almost double the unit's rated power. This is particularly important when driving loads which demand a high start-up current, such as lamps and induction motors.

Finally, we tried to upset the 200i by simulating the type of abuse it might typically encounter in the field (so to speak). Despite the potential for dramatic results, this turned out to be somewhat of an anticlimax, since the unit simply shut down in response to gross output overload, and would not thermally overload even when the airflow was restricted by the judicious application of a couple of woolly jumpers — very real-world indeed!

In short, the 200i passed its performance tests with flying colours, and should provide true worry-free operation. With a standby current of only 150mA, you could safely leave the unit connected for an extended period and simply connect 240V loads as they are needed.

While we're a little mistrustful of cigarette lighter power plugs in general — the matching socket tends to corrode and

The PROwatt 800i uses the same high frequency switchmode techniques as the 200i, but is rated at 800W and offers a number of LED readouts on the front panel.

Statpower's hi-tech DC-AC inverters

compromise the connection — they are a very quick and convenient method for powering the inverter for occasional use. As recommended in the owner's manual for the 200i though, if the inverter is to be used for extended periods at power levels above 150W, the existing power plug should be removed and heavy-duty battery clips fitted, or the unit wired permanently to the source via a high-current isolating switch.

Unfortunately, when it came time to check the performance of the PROwatt 800i we found that our sample unit would not produce a 240V AC output, despite the fact that it was clearly receiving power from the battery. This however, gave us good reason to remove the bottom cover and take a look at the 800i's internals.

The problem was quite easy to rectify as it turned out, since two of the leads which connect the PCB to the 240V outlet had been transposed during manufacture, leaving the socket's active and neutral pins at the same potential — we swapped the leads, and the unit performed as expected. Nevertheless, a 240V AC wiring problem such as this is indeed worrying, and we are assuming that this was an isolated case confined to our sample unit.

The 800i appears to be very well constructed internally, with one large PCB occupying all of the box space, and at least twenty TO-220 style switching MOSFETs arranged around its perimeter. All use the chassis as a heatsink. The DC-DC converter seems to be split into four sections to share the load (as each is supplied by a separate 30A automotive blade-style fuse), and uses surprisingly small switchmode transformers — as a testament to the circuit's efficiency, there isn't really a large heavy-duty component to be seen.

In a similar manner to the 200i, the more powerful 800i delivered impressive performance at all output power levels. Its efficiency was generally greater than 90%, and the output voltage well sustained right up to the point where our 12V battery could no longer handle the pace. As it turned out, *this* was the limiting factor in our performance tests rather than the inverter itself, since at output power levels of more than about 600W, the battery voltage began to fall significantly. This in turn caused the inverter's low battery alarm to sound, and eventually shut down its output.

Battery performance is of course critical in this kind of application, and as again recommended in the owner's manual, an inverter's DC power source must be well up to scratch if the unit is to successfully deliver its rated output. In short, for an inverter with the capabilities of the 800i, it really should be driven from two or more 12V batteries in parallel, via *very* heavy-duty connecting cables. (Note that the 800i is also available in a 24V version, which would relieve the situation somewhat by effectively halving the required battery current.)

In virtually all other respects, the 800i's characteristics matched those of the smaller 200i. Its output frequency was very close to the required 50Hz, the protection circuitry functioned well, and its short-term power seemed well in excess of its rated power — although we couldn't perform a thorough test here, as once again, our trusty battery ran out of steam. Other than that, the front panel battery voltage and current meters are more than accurate enough to provide the user with useful information on the input conditions, and the unit's idling current is around 300mA once the on/off switch is moved to the 'on' position.

Note that this light-duty switch appears to simply enable the inverter's output switching action (and therefore the 230V AC output), and the DC-DC converter remains active as long as the 12V source is connected — in the 'off' mode however, the idling current is low enough to be considered insignificant.

Conclusions

As you've no doubt gathered, we were very impressed with the Statpower PROwatt models 200i and 800i supplied for this review. Designed and built in Canada, these units show how high-frequency switchmode circuitry can vastly improve the design of DC to AC inverters, without compromising performance or generating troublesome interference signals.

Incidentally the 200i has been uprated to 250W and is now designated model 250i (as you might expect). There are also two other models available in the PROwatt range: the even smaller 125i (125W), and the potent 1500i (1500W!). In the 12V version, the 1500i would theoretically need a source current of more than 125 amps, without incurring a significant voltage drop — we suspect that the 24V version would be a little easier to deal with...

The PROwatt 125i, 250i, 800i and 1500i are priced at $208, $395, $998 and $1709 respectively, and are available from Bainbridge Marine Pty Ltd, at 3/16 Veronica St, Capalaba, Qld 4157; phone (07) 245 2033. ❖

Computer hardware review:

0 - 12MHz DDS on a PC card

Novatech Instruments has released a new low cost 0-12MHz direct digital synthesis signal source, on an ISA bus card compatible with PC XT, AT and later IBM-compatible computers. The DDS3-PC provides both sinewave and HCMOS/TTL compatible squarewave outputs, includes a programmable 70dB step attenuator for the sinewave output and comes complete with driver software to 'get you going'.

by JIM ROWE

Back in the April 1993 issue, you may recall, we reviewed a really low cost kit for a 0 - 12MHz programmable signal source based on the Qualcomm Q2220 DDS (direct digital synthesiser) chip. The DDS3 kit was from Novatech Instruments, a small but dynamic firm based in Seattle, Washington USA, which was selling it internationally for only US$129.95 including shipping.

I gather that the DDS3 kit has been very successful, and that a significant number were sold to Australian customers following both our initial review and our later publication of a design to interface it to the serial port of a PC (*EA*, July 1993).

Encouraged by this success, Novatech has produced a new version of the DDS3 — this time a fully assembled and tested unit rather than a kit, and now designed to plug directly into an eight-bit ISA slot of an IBM-compatible PC.

The new DDS3-PC is built on a short-length ISA-bus card, and offers a number of features over and above those of the original kit. Probably the most important feature is that because it now plugs directly into the PC's data and address buses, it can be programmed much more rapidly and efficiently for applications which require frequency sweeping, etc. There's no limit imposed by a serial interface, as there was with our own attempt to interface the original DDS3 with a PC.

To allow more flexible control over the sinewave output amplitude, the DDS3-PC now also includes a 70dB step attenuator, programmable in 10dB steps from +20dBm to -50dBm and again under direct software control. It now also has provision for feeding in an external master clock signal for the DDS chip, as an alternative to the 33.5544MHz crystal oscillator on the card itself.

The external clock signal can be of any frequency up to 40MHz, and switching between the two is again under direct software control. In short, then, the DDS3-PC offers quite a bit more than the original kit, as well as being a fully assembled and tested product. Despite this, its cost is still very reasonable indeed: US$399 plus handling and shipping, which equates to around A$630 at current exchange rates.

Since there's virtually no other PC-programmable DDS-based signal sources available at anywhere near this price, the DDS3-PC should therefore be of considerable interest to circuit designers, testing engineers and even experimenters and radio hams. In fact it would be very well suited for use in ATE applications, as a low cost and readily programmable test signal generator.

Impressive specs

Like the original kit, the DDS3-PC is based on a Qualcomm Q2220 DDS chip, coupled to a Motorola MC10322 high speed video DAC. The raw 'sampled sinewave' signal from the DAC then fed to an 11th-order low pass filter (corner frequency 13.5MHz), to remove spurious components, and then to the output attenuator and square-wave shaping circuitry (see diagram).

As before the Q2220 is driven from an on-board master crystal clock running at 33.554432MHz, which gives 2Hz as the minimum output frequency and also the minimum frequency increment. The output frequency can thus be set to any even frequency between 2Hz and 16MHz, although the output purity, etc., is only specified up to 12MHz.

The rated frequency accuracy using the on-board clock oscillator is +/-5ppm, at (25 +/-2)°C, over 24 hours. Similarly the stability is quoted as +/-10ppm/year, between 20°C and 30°C.

Both the sinewave and squarewave outputs have a source impedance of 50 ohms, with the sinewave output providing a maximum output of +20dBm (2.2V RMS) into 50 ohms or +26dBm (4.4V RMS) into an open circuit. The squarewave output conforms to HCMOS/TTL logic levels. Of course the sinewave output can also be switched in 10dB steps, through 70dB of attenuation, to less than 1mV.

The quoted spectral purity figures for the sinewave output are quite impressive, with phase noise below -90dBc within a 1kHz offset, spurious outputs typically lower than -55dBc below 5MHz (-45dBc from 5 - 12MHz) and harmonics below -50dBc below 5MHz (-40dBc below 12MHz).

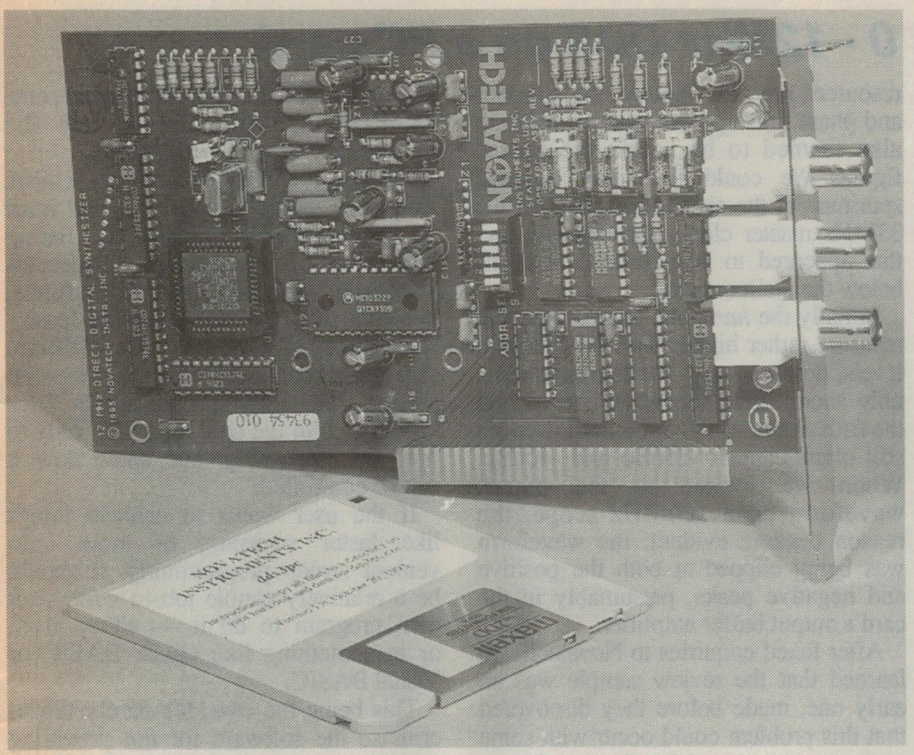
The Q2220 DDS chip itself can be switched from one output frequency to another in a very short time — around 100ns. This means that in the DDS3-PC, with its direct programming from the PC bus, there's the potential for very fast frequency switching and sweeping. The attenuator control circuitry uses small relays, and is somewhat slower — each change can take up to 10ms.

The power requirements for the DDS3-PC card are very modest: less than 250mA at 5V, less than 100mA at -5V and below 50mA from +/-12V. These should be within the capabilities of virtually any PC's power supply.

Driver software

The DDS3-PC card basically occupies a range of six contiguous addresses in the PC's I/O space, with the base address set to 0338H as supplied. However an on-board DIP switch allows the base address to be set anywhere from 0220H to 03F8H in 08H steps, to allow relocating it in the event of clashes with other cards.

Programming the DDS3-PC in terms of both output frequency and sinewave output amplitude (as well as internal/external clock selection) is performed simply by writing to the appropriate addresses. Four of the addresses are used to



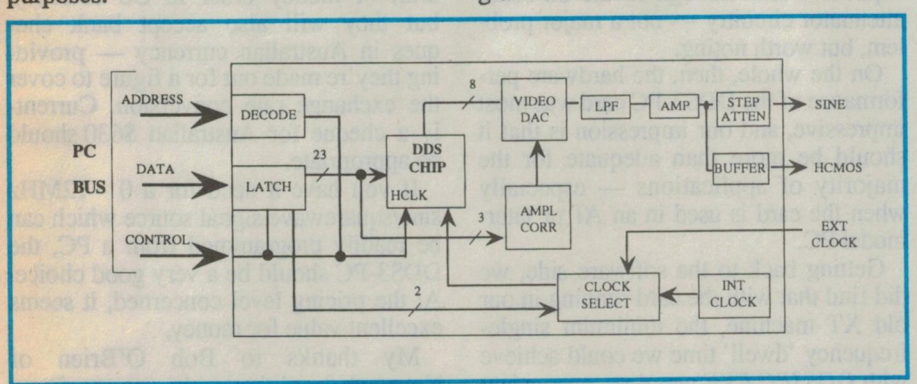
The Novatech DDS3-PC card complete with matching software disk. It also comes with an informative user manual. The three BNC sockets on the mounting bracket provide sinewave output, squarewave output and external clock input.

load the actual programming data, while the fifth address is used to generate the 'HOPCLK' pulse which directs the DDS to 'read' a newly-loaded frequency setting, and the sixth to produce an overall card reset. Both of the latter functions are achieved by performing 'dummy writes' to the addresses concerned (i.e., the actual data written is not used, only the decoded write-strobe pulse).

Although this is all quite straightforward, and full details are given in Novatech's user manual, the company also makes things even easier by supplying the DDS3-PC with a sample driver program, on floppy disk. Called *DDS3PC*, it's provided in both executable EXE form and the original C language source code — for those who would like to adapt it for their own purposes.

The *DDS3PC.EXE* program can be used in either of two modes, designated 'immediate' and 'file' mode respectively. In immediate mode the program is simply called by name alone, and initially asks you for the card's address setting and whether or not its on-board clock is to be used. Then it simply asks you for the desired output frequency and attenuation settings, and when these are supplied it feeds them to the DDS3-PC. Further frequency and attenuation settings can be fed in, simply by typing them in.

To use the program in 'file' mode instead, a suitable script file must be prepared first using a word processor or text editor. When the file has been created, it can then be used to control the program by specifying it as a parameter following the 'DDS3PC', when the program is called.



The block diagram for the DDS3-PC, as supplied by Novatech in the user manual.

The script files are quite simple, using six basic commands: *addr XXXX*, to set the I/O address if it's other than the default 0338H; *clock XXXX*, to specify an external clock frequency; *out XX YY ZZ*, to specify an output frequency, attenuation factor and 'dwell time' (for sweeping); and *start* and *stop*, commands used to signify the beginning and end of a sweeping loop. Comment lines can also be included in the script files, if they begin with a hash character (#).

Novatech actually provides three sample script files on the disk, to show how it's done. In fact these are simple test routine scripts, used as part of the DDS3-PC checkout procedure described in the user manual.

The *DDS3PC.EXE* program automatically senses the clock speed of your PC when you fire it up, taking about 10 seconds to do this. Then it's arranged to be able to time frequency sweeps in increments of as short as 1ms per step, and make up to 10 attenuation changes per second.

By the way, the program will accept scientific notation for any of the numeric parameters, in both immediate and file modes. So 'out 1e6 10 1e-2' in a script file will produce an output frequency of 1MHz with an attenuation setting of 10dB, and lasting for 10ms. The program is also designed to allow you to type in a '0' for the I/O address and clock frequency, to signify that it's to use the default settings.

Trying it out

Novatech very kindly sent us an evaluation sample of the DDS3-PC, so we could check it out for ourselves. We tried installing it in both an elderly IBM XT machine and a 12MHz/286 AT-clone, and in each case the job turned out to be very straightforward. The instructions in the user manual were quite clear, and we didn't even have to change the card's default I/O address of 0338H; it didn't cause a clash, in either machine.

Control of the card's output frequency and sinewave amplitude using the *DDS3PC.EXE* program was also quite straightforward, although after a while we had a minor gripe or two in terms of user convenience. But more about these shortly.

On the hardware performance side, the frequency accuracy and stability of the DDS3-PC turned out to be excellent. Compared against our TV-derived frequency reference, it measured within 0.2ppm — i.e., within 2Hz at 10MHz. This is well inside the quoted specification.

Although our spectrum analysis

0 - 12MHz DDS on a PC card

resources are only modest, the spurious and phase noise performance of the card also seemed to be within the quoted figures. We could find only a small spurious at the second harmonic of the 33MHz master clock, for example, and this appeared to be a little over 55dB below the main output.

Initially the *harmonic* components did measure rather higher than the specified levels, however, with the third harmonic only about 20dB below the carrier, and the fifth and seventh harmonics lower but still significant at -35dBc and -40dBc. When we looked at the output waveform on a 100MHz scope, the reason became evident: the waveform was being clipped at both the positive and negative peaks, presumably in the card's output buffer amplifier.

After faxed enquiries to Novatech, we learned that the review sample was an early one, made before they discovered that this problem could occur with some component combinations. Since despatching our card they had developed a simple fix for the problem, however, and they kindly faxed the details so we could try doing it ourselves.

After making the mod, the waveform clipping disappeared and the amplitude of the harmonic components duly dropped down to below the -50dBc level quoted in the specification. By the way, Novatech say that all cards now being sold have definitely been fitted with this modification, so we were just unlucky.

The only other small hardware-related problem we encountered was that at high settings for the programmable output attenuator (specifically the -40, -50 and -60dB settings), a small amount of 'ringing' appeared at the positive and negative peaks of the waveform, with a corresponding appearance of high-order harmonic components in the spectrum, between about 70MHz and 110MHz. Presumably this is due to capacitive leak-through in the on-board attenuator circuitry — not a major problem, but worth noting.

On the whole, then, the hardware performance of the DDS3-PC card was most impressive, and our impression is that it should be more than adequate for the majority of applications — especially when the card is used in an AT or later-model PC.

Getting back to the software side, we did find that with the card running in our old XT machine, the minimum single-frequency 'dwell' time we could achieve with *DDS3PC.EXE* was 4ms, even when we keyed in a value of 1ms. Presumably this was due to the program having some kind of problem adjusting to the machine's 4.77MHz clock speed.

We also found that in order to achieve frequency *sweeping*, the program must be provided with a script file listing every one of the specific frequencies concerned — and their dwell times. Which is rather clumsy, to say the least.

Of course as Novatech's Bob O'Brien stresses, the *DDS3PC.EXE* program, source code and sample script files provided with the card are really only to 'get the user going' and show how it can be controlled.

If the user wants to achieve things like faster sweeping or more convenient sweep programming, it should be a relatively simple job to write your own program to do it — either in C, or in something like Quick BASIC or Visual BASIC.

This being the case, it's hardly fair to criticise the software for not providing 'all things for all users'. There's no doubt that it's more than adequate to allow users to check out their card, and put it to initial use.

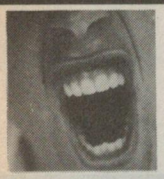
By the way another US firm, which markets a Windows-based ATE package called 'ATEasy 2.0', has already produced a driver of its own for the DDS3-PC. The firm is Geotest Inc., of 18242 West McDurmott Street, Irvine, California 92714, USA; phone (714) 263 2222, or fax (714) 263 1203.

And how do you get the DDS3-PC card and disk package itself? Basically by ordering it directly from Novatech Instruments, of 1530 Eastlake Avenue East, Suite 303, Seattle, Washington 98102, USA; phone (206) 328 6902, or fax (206) 328 6904. As mentioned earlier the cost including handling and shipping is US$409, which should be sent with your order.

Understandably Novatech prefers to get this payment as a bank cheque, draft or money order in US currency, but they will also accept bank cheques in Australian currency — providing they're made out for a figure to cover the exchange rate conversion. Currently a cheque for Australian $630 should be appropriate.

If you have a need for a 0 - 12MHz sine/squarewave signal source which can be readily programmed from a PC, the DDS3-PC should be a very good choice. At the pricing level concerned, it seems excellent value for money.

My thanks to Bob O'Brien of Novatech for giving us the opportunity to try one out. ❖



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Main - 50nS to 2S per div with 24 ranges
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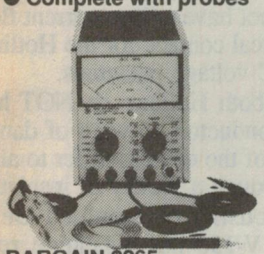

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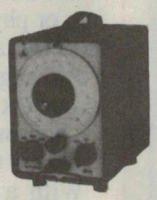

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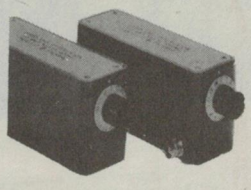
- 0 to 120db
- 10 db Steps
- DC to 1000 MHz



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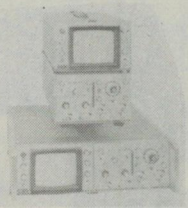

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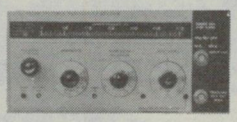

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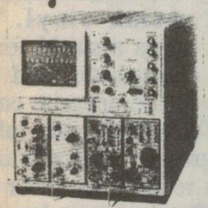

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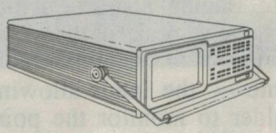

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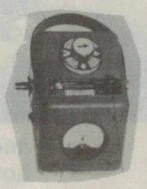

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HP 312A	Selective Voltmeter to 18MHz	$250	HP 8007B	Pulse Generator to 100MHz	$850			
HP 410B	VTVM 20Hz-700MHz AC/DC/ohms	$145	HP 8600/8601	110 MHz RF Sweep Marker System	$1475	WHITWORTH THREAD TAPS (new)		
HP 419A	DC Null Voltmeter	$275				1/8", 3/16", 9/16" Sets	3pcs/$3.00	
HP 435B	RF Power Meter	$950	HP 8614A	0.8 - 2.4 GHz Signal Generator	$1750	1/2" Sets	3pcs/$5.00	
HP 436A	Thermocouple RF Power Meter	$1400	HP 8640B	Sig Gen 100KHz1000MHzAM/FM	$4950			
HP 778D	Dual Dir.Coupler 0.01-2GHz	$1500	HP 11692D	Dual Dir.Coupler 2-18 GHz	$2600	ANTI STATIC MATS (new)		
HP 1640B	Serial Data Analyser	$650	HP 15148B	Sound Level Detector	$150	Laminated with wrist straps	$35	
HP 1645A	Data Error Analyser	$70	HP 60155C	DC Power Supply	$220	Rubber with wrist straps	$45	
HP 3400A	True RMS Voltmeter	$425						

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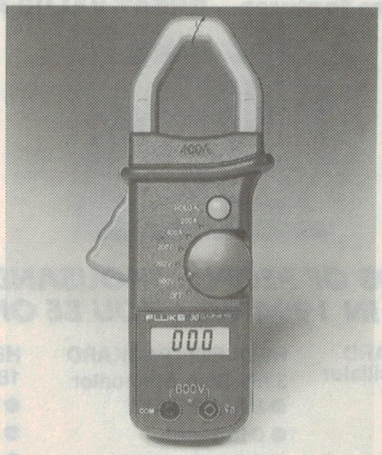
NEW PRODUCTS

Fluke clamp meter

The new Fluke model 30 Clamp Meter meets Fluke's standard for ruggedness, and has been tested to withstand a two metre drop. Measuring AC current to 400A and AC volts to 600V, the new unit is well suited for commercial, industrial and residential electricians, as well as HVAC/R (heating, ventiation, air conditioning, refrigeration) service technicians. Its tapered jaws, with centred opening, make it easy to access conductors in crowded junction boxes.

In addition, the Model 30 is more accurate and easier to read than low cost analog meters, with a HOLD button, to freeze the display. The 1.3% accuracy of the new Model 30 Clamp Meter is specified for one year after calibration. The unit operates from -10°C to +50°C on a standard 9V battery.

For further information circle 244 on the reader service coupon or contact Philips Test and Measurement, 34 Waterloo Road, North Ryde 2113; phone (02) 888 8222.



AC voltage detectors

The V-150 and ESP Hotliners, handheld AC voltage detectors from Fisher Detecting Equipment will locate the presence of AC potentials above 60V in wires, fixtures, tools and other conductive surfaces — all from a safe distance. There does not have to be a current flowing, or physical contact, for the Hotliners to detect AC voltage potentials.

Although both Hotlines do NOT have to contact conductors to warn of danger, the housing of the devices differ to allow detection through a variety of insulation.

With a housing of moulded Delrin plastic, the V-150 has insulation resistance of 1kV. It will find 'hot' wires, grounding faults, current leakage, charged water meters, and induced voltages in metal structures.

The ESP model has an insulation resistance of 50kV. It is housed in two heavy duty telescoping aluminium tubes encased in heat shrink vinyl. The aluminium tubes act as a shield for the sensor, with the electrostatic field only entering the tube at the opposite end to the handle. The further the outer tube is pulled out, the greater the standoff, so that sensitivity is reduced to lower voltages and the ESP only responds with a solid tone to higher voltages.

Applications include checking the electrostatic field surrounding ungrounded or poorly grounded cables; testing guy wires to utility poles for voltage potential; detecting electrostatic field around unshielded cable; and checking water meters for conductors crossing water lines.

The V-150 retails for $140 while the ESP sells at $350. Both units come with a five year limited warranty and battery life is estimated at 200 hours.

For further information circle 243 on the reader service coupon or contact

Easy to install wireless security

The new Moss Security MS2000, which comes ready to fit is aimed at consumers who want a security system at an affordable price. The system contains five elements: a wall-mounted control panel, one infra-red motion detector, one door/window detector, a portable remote control unit and an external siren.

The control panel, which is slim and unobtrusive, is powered via a mains power adaptor plugged into a power point. Operation of the system requires the input of a four or five digit number, which can be selected and programmed by the user.

The panel has three settings, Off, Away, and Home — the latter allowing the householder to monitor the points of entry and exit but still move freely inside the house.

The infra-red motion detector will pick up movement over a distance of nine metres while the door/window detector is triggered if the door is opened while the alarm is turned on. The alarm can be set at the control panel or via the pocket sized remote control, which is similar to a car alarm remote control. It can also be used as a portable panic button to trigger the alarm and gain attention if necessary.

For further information circle 241 on the reader service coupon or contact Moss Security, 1/29 Prince William Drive, Seven Hills 2147; phone (02) 674 6099.

Tiny HF transceiver

Kenwood Electronics has introduced what is claimed to be the world's smallest HF transceiver, the TS-50S. Designed for operation on 160 through to 10m amateur bands, plus continuous reception coverage from 500kHz through to 30MHz, the transceiver also supports SSB, (LSB and USB), CW, AM and FM modes of operation.

Measuring only 179mm wide, 60mm high and 233mm deep and weighing only 2.9kg, the TS-50S is designed for the ham shack, office and mobile installation. Although small in size, it packs 100W in SSB, CW, FSK and FM modes, and incorporates a cooling fan which automatically maintains optimum temperature distribution. Offering up to 100 channels for storage of transmit and receive frequencies, the unit can also hold both the A and B VFO frequencies, enabling FM split-frequency repeater operation. Similarly, in TF-SET mode the operator can 'lock' the receive frequency and then find the best frequency at which the DX station is located.

Kenwood employs its proprietary DDS (direct digital synthesiser) with 'fuzzy' logic control circuitry, which enables the encoder to tune from steps as small as 5Hz to fast forward mode. The TS-50S also facilitates scanning in all frequency modes, while its advanced intercept point system is capable of raising the dynamic range to 105dB.

The RRP for the TS-50S is $1589. For more information circle 245 on the reader service coupon or contact Kenwood Electronics Australia, 8 Figtree Drive, Homebush 2140; phone (02) 746 1888.

Fisher Detecting Equipment, 5 Kiama Street, Miranda 2228; phone (02) 54646111, fax 544 7766.

'3D' scientific calculators

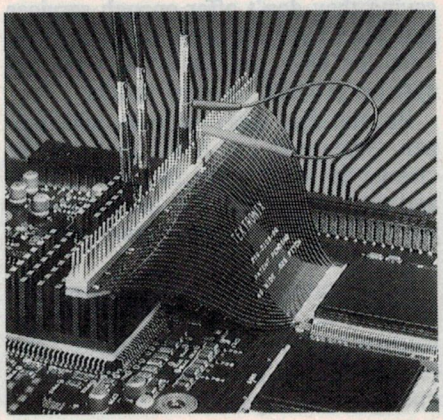
Hewlett-Packard has introduced two new scientific calculators that feature 3D plotting and other advanced features previously unavailable in handheld calculators. The models HP48GX and HP48G have a suggested retail price of $595 and $325 respectively, and replace existing models 48SX and 48S. The 48GX has 128K of internal RAM and accepts plug-in expansion cards. The 48G has 32K of RAM and has all the features of the HP48GX minus the expansion capability.

In addition to many new graphical features, the new range have more PC like interfaces with pull down menus and 'forms' to fill in. One added bonus is the Equation Library. This library, which was optional plug in card, is now fully integrated into both models. Both models are available now from calculator and computer stores.

For more information circle 242 on the reader service coupon or contact Twinlock Acco, 27 Clarinda Road, South Oakleigh 3166; phone (03) 544 4000.

Adaptor simplifies SMD probing

Tektronix has announced a new concept in fine pitch probing, the Tektronix FlexLead Adaptor. When connected to the device under test, the FlexLead Adaptors permit convenient probing of 25mil pitch and smaller packages. The growth of fine pitch surface mount packages has resulted in a difficult probing problem, which this adaptor addresses.



The FlexLead Adaptor is constructed of pliable 2mil polyimide. The adaptors are soldered to the leads of fine pitch SMD packages by heating the adaptor's fingers.

At the opposite end from the package is a standard interface of two rows of square pins on 100mil centres to which an oscilloscope or logic analyser probe can attach.

One row of square pins connects to the leads on the package, while the other row of square pins are bussed together and connected to one or more package pins that are grounded. Self aligning guides insure perfect pin alignment, simplifying connection to the device.

The ability to flex and bend the adaptors enables connections to packages in close proximity to each other. The adaptors are easily removed without causing any damage to the device being tested.

The FlexLead Adaptor provides a convenient attachment to small geometry devices with minimum circuit loading (typically 2pF, depending upon package size). The adaptors are designed for use with the new Tektronix TLS, TDS, TAS and 2400 series oscilloscopes, and are also compatible with a wide range of other Tektronix oscilloscope and logic analyser probes.

For further information circle 247 on the reader service coupon or contact Tektronix, 80 Waterloo Road, North Ryde 2113; phone (02) 888 7066. ❖

Silicon Valley NEWSLETTER

Gates says 'industry can pay'

President Clinton has made building the data super-highway a top priority of his Administration's aim of rebuilding America's industry. But Microsoft chief Bill Gates told the San Francisco Commonwealth Club that while Clinton will get his digital infrastructure, it will not have to cost the US taxpayer a single penny.

Connecting every home and business with a fibre optic cable network could cost as much as US$100 billion, but Gates said there are plenty of entrepreneurs in the US who are ready and willing to build it. "In my opinion, the government doesn't have to spend a dollar of taxpayer money to build it. There are a lot of great entrepreneurs willing to make this happen and take the risk."

Gates said Microsoft is currently investing US$100 million a year in developing technology for products designed to take advantage of the market opportunities offered by a data super-highway. In addition, Gates said he has put Microsoft into a number of alliances which will allow Microsoft to provide critical 'nuggets' of software technology to be implemented on the data super-highway.

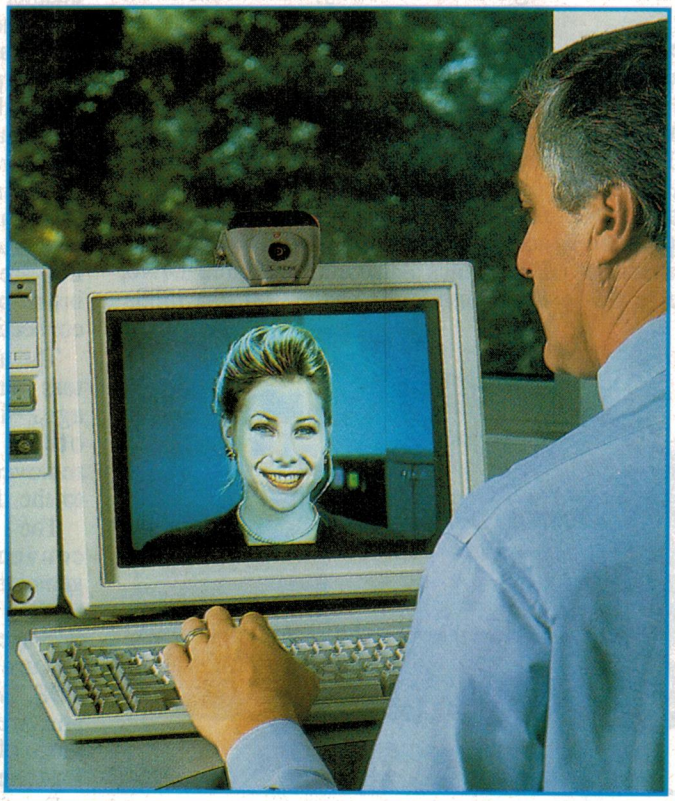
While the government doesn't have to put up the money to build the network, Gates said there is a definite role for Washington to play. Gates said the government should focus on developing uniform regulations, governing new forms of communications and information distribution over the new network.

Gates also said that he has a different vision of how the digital super-highway will develop. Most reports have focused on the 500 channels of television and information which will come into people's homes. Gates said the first contact most people will have with the new technology is through information kiosks in hotels, airports and trade conventions.

Gates said he has been personally disappointed with most of the trial programs that have been under way, saying they don't offer enough services and don't have adequate user interfaces. "All we have proven is that crummy systems produce crummy results."

But the data super-highway will happen, Gates said, and it will dramatically change the way people live, work, learn and play. "I think it will have powerful positive effects for most every area of work and home life."

In particular he believes education will benefit, as the network will allow teachers to share their experiences. "We can have the best practices spread throughout the system."



At the recent Comdex show in Las Vegas, North Carolinan firm Twincom demonstrated the C-Phone — a hardware and software package which converts a PC into a teleconferencing terminal. C-Phone works with either Novell or Artisoft networking software.

Is it a PC, CD or TV? No, it's a Macintosh

Apple Computer has announced a new version of a high-end Performa 650 Macintosh which doubles as a colour television and stereo CD. The so-called 'Macintosh TV' will retail for US$2079, and can display both computer data and television pictures onto its 14-inch display. A remote control device controls both the TV and the CD player, which doubles as a CD-ROM drive. While watching a TV program, users, operating their mouse, can freeze a TV picture and store the 'snapshot' onto their disk drive and incorporate the image into word processing or other documents.

"The MacTV is Apple's first machine with a built-in TV tuner. The computer comes in a black case to make it look more like a consumer electronics product than a computer system," Apple product manager Bruce Gee explained. He added that the MacTV will be produced in a limited quantity, as it is partly an experimental product from which Apple hopes to learn a lot about how people will be able to use this type of machine.

Gee said the MacTV will be aimed at people who like to combine work and fun. "I love TV. Now we can work late, sitting in our cubicle with a pizza and watch our favourite programs too."

Sculley cleans house at Spectrum

Less than a month after hiring a big time executive, Spectrum Information Technologies was undergoing big time changes as John Sculley moved to reshape the US$100 million wireless communications technology licensing company.

Sculley's actions were designed to put a considerable distance between the new

Spectrum and its pre-Sculley past. He ordered a US$15 million settlement in a shareholder's lawsuit which had been filed amidst allegations of questionable stock practices.

Sculley also removed three of Spectrum's top executives — including Dana Verrill, the company's founder who hired Sculley. And finally, the new chief executive announced the purchase of a small engineering company.

The announcements came just days after a report in a leading US computer industry weekly stated that Sculley was having second thoughts about joining Spectrum. Spectrum has denied there is any validity to the rumour.

Spectrum also announced for the first time what it will be paying the former Apple executive. In addition to a US$1 million a year salary, Sculley will receive 18 million stock warrants which could give him a profit of US$60 million.

Chip market heads for $100B in 1996

With order and shipment levels running at record levels for much of the year, it is no surprise that 1993 will go down as one of the best in the industry's history. But with PC demand expected to slow down from the frantic levels of the last year, chip orders will also see a significant decline in growth rates in 1994 and 1995.

At its annual semiconductor forecast meeting, the Semiconductor Industry Association said worldwide chip shipments improved 29% in 1993 to US$77.3 billion. By the end of the three year outlook, it expected the market will have swelled to US$103 billion in 1996.

The huge boost in chip sales last year, according to SIA president Andy Procassini, "is due to increased demand for chips used in personal computers and related applications. We predict continued growth through 1996 and the attainment of a $100 billion market."

The 1993 year saw the US market exceed the Japanese market for the first time in almost a decade. Japan's market rebounded from a decline in 1992 to US$19.4 billion, while the US market grew 22.3% to US$23.7 billion. Japan's chip market is expected to keep pace with the US market during the next couple of years and grow to $31 billion in 1996.

Industry analysts said that while chip makers are enjoying the current boom in business, their future is actually getting increasingly uncertain as the industry is depending increasingly on the desktop computer market. Doug Audrey, who heads the industry statistics division of the SIA, said that "we figure that the computer segment accounts for 50 to 55% of US semiconductor consumption. So what happens with computer sales has a big impact on the industry."

Atari lets 64-bit Jaguar out of cage

At a crowded New York press conference recently, Atari let its Jaguar out of its cage — hoping the new video game system will be able to grab a big chunk of the US$6 billion video game market which the company once dominated.

The Jaguar is the industry's first 64-bit based video game player, putting Atari at least 18 months ahead of industry leaders Nintendo and Sega. Nintendo has said it will not be able to launch a 64-bit machine until late 1995, and will bypass the 32-bit generation altogether.

Atari's Jaguar, which is manufactured for the company by IBM, will retail in the US for US$250. Initially only four games will be available, for between $40 and $70 each. Atari's hopes are riding on the advanced graphics capabilities of the 64-bit processor, which could allow game designers to design full motion video games for the machines.

While many industry executives and analysts have remained skeptical about Atari's chances for a comeback in the video game market, at least on Wall Street investors have given Atari a big vote of confidence.

At the press conference, Atari chief Jack Tramiel boasted that the Jaguar has about 100 times the power of the Super Nintendo and Sega Genesis systems, and more than twice the performance ability of the 32-bit CD-ROM based game player from 3DO.

Tramiel said his company expected to ship about 30,000 units by Christmas, to retail stores in New York and the San Francisco Bay area. Then in January, the machine would become available in the rest of the US. Tramiel also said that already some 30 game design companies have signed on to support the Jaguar with new games.

For Atari, the Jaguar represents a 'do-or-die' effort. Tramiel has pledged to focus all of Atari's remaining financial resources on the launch of the Jaguar. If the product fails, Atari will most likely be out of business. If it succeeds, the profits will be used to support future upgrades as well as the company's struggling PC business.

Microsoft hails sentence for MS-DOS pirates

Microsoft recently sent out a press release commemorating the start of the one year sentence of Benny Lee, who was convicted of selling 25,000 counterfeit copies of MS-DOS. The conviction was the result of a case delivered to the Santa Clara Country District Attourney's office by Microsoft, which had investigated Lee's company.

The case began in 1990 when Microsoft filed a civil lawsuit against Lee, nine other individuals, and six small companies which Microsoft claimed had conspired to sell 25,000 counterfeit copies of MS-DOS for US$1.8 million.

In 1991, Lee and his business partner Norman Chan lost the civil case and were ordered to pay Microsoft US$5.3 million in damages. When the two men declared bankruptcy and refused to pay the fine, Microsoft referred the case to the DA's office.

In a subsequent trial, Chan, who pleaded guilty testified against Benny in return for a six month 'home detention' sentence. Upon his conviction, Lee was sentenced to a one year jail sentence.

"We are pleased that the US Attorney's office upheld its commitment to see that offenders are prosecuted to the fullest extent of the law," said Microsoft attorney Jim Lowe.

Internet intruders steal passwords

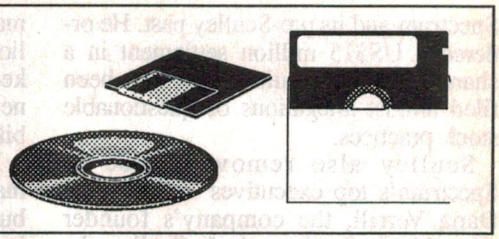
Computer network intruders have allegedly made off with passwords for thousands of corporate university and government computer networks connected to the Internet computer networks.

The theft of the passwords occurred last October when 'Panix', a New York online service company, was forced to shut down when its network had been attacked by hackers. In all, as many as two million computer systems hooked up to Internet are at risk, as the intruders have access codes to get into thousands of local networks.

According to new police reports, on October 18, the staff at Panix discovered that an outside intruder had planted a so-called 'Trojan Horse' program into Panix's network system. The program was designed to monitor data communication on the Panix network and record password information in a secret file. That file was subsequently accessed remotely by the intruder(s), giving the intruder hundreds of passwords to use for breaking into computer systems worldwide.

Authorities said they still have no idea how many computer systems may have been compromised, or whether any data had been stolen or damaged as a result of the attack. ❖

SPOTLIGHT ON SOFTWARE



SnapGrafx: for fast diagrams and tables

Well known for its *Picture Publisher*, *Designer* and *Windows Draw* packages, Micrografx Inc has now released a package expressly designed to facilitate fast and easy production of block diagrams, bar charts, flow charts, 'timeline' charts, comparison tables, organisation diagrams and many other graphics for business and technical reports.

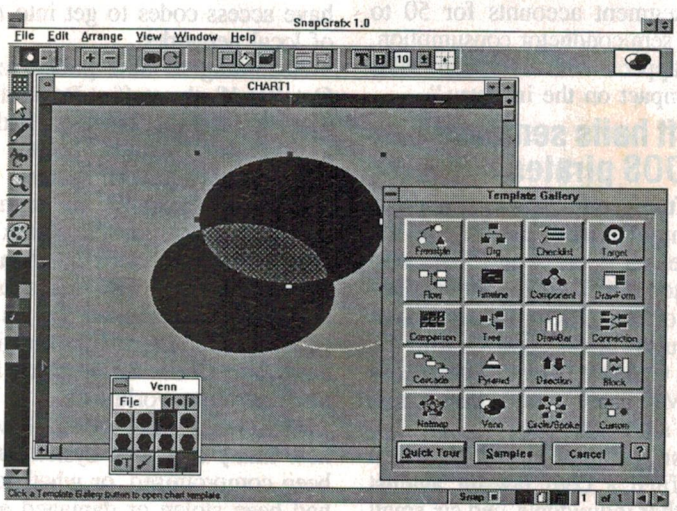
by JIM ROWE

Gone are the days of the typing pool, in most organisations, and most of us have to turn to the trusty PC and word processor when we need to write a report, paper or article, etc. Similarly, if it still exists the drawing office is likely to be too busy to undertake the production of small diagrams — so again, it usually tends to be a case of 'do it yourself', if you want a diagram or two.

Of course many of the newer word processors have inbuilt facilities for drawing simple diagrams, as do many of the modern spreadsheets. Or as an alternative, you can turn to a full-scale drawing package like *Corel Draw*. The trouble is, many of these 'general purpose' packages are in some ways too powerful and 'open ended' to let you quickly knock out simple block diagrams and bar charts. In an ideal world it would be nice to have a dedicated package, which already 'knew' how to draw a range of commonly-used diagrams, and let you simply 'plug in the details'.

The new *SnapGrafx* package from Micrografx is just such a package. It comes with a set of built-in 'templates', for some 19 different commonly-used diagrams, charts and tables, plus the ability to produce extra customised templates of your own. Often all you need to do once you've called up a template is select component shapes, type in your text and print it out — or copy it over into another package, as you wish. In some cases you might need to change the layout around a little before you're finished, but if so the program is designed to make this very quick and straightforward.

SnapGrafx runs under *Windows 3.1*, and hence needs a fairly fast computer based on a 80386 or better, with a VGA or better graphics, 2MB or more of RAM and a mouse. It comes on a single 3.5" floppy disk, and instals very easily under *Windows* via a standard INSTALL program on the disk. Together with its templates and samples it takes up about 3.5MB on your hard disk.



The 'Template Gallery' (right) provides a good selection of graphics templates.

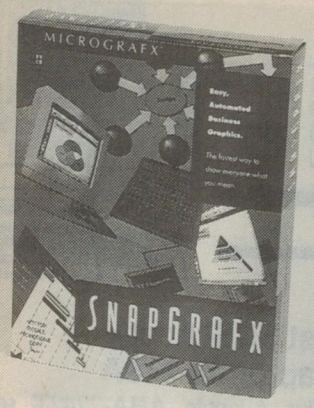
If you're familiar with Micrografx's excellent image editing and manipulation package *Picture Publisher*, many aspects of the *SnapGrafx* user interface will seem familiar. Even if you're not, you should still find it very easy to use, as it has lots of friendly and intuitive features — a set of 'toolbox' buttons down the left-hand side of the screen; a 'hint line' along the bottom to give you information on the button or screen area currently underneath the mouse cursor; a ribbon of 'short cut' buttons along the top (under the menu bar), which changes to suit each kind of graphic template; and of course context sensitive online help (which in this case includes a 'Quick Tips' facility).

Like a lot of the latest packages it also provides a built-in interactive tutorial, which in this case is called 'Quick Tour' and is divided into three sections: Basic, Nifty and Extra. There's also a set of sample diagrams, to demonstrate how each of the templates is used...

When *SnapGrafx* is started up, you click on the top toolbox button to call up the 'Template Gallery'. Then it's simply a matter of clicking on the button for the template you want, and up it comes. With each one comes a matching Shape Palette, for rapid selection of component box shapes and colours, arrows and flow symbols, etc.

The standard range of templates covers:

- 'Top down' organisation charts
- Horizontal 'tree' charts
- Bar graph or 'drawbar' diagrams
- Flow charts
- Project 'time line' charts
- Venn 'class' diagrams
- 'Pyramid' hierarchy charts
- Block diagrams
- Connection diagrams



- Cascade charts
- Trend or 'direction' diagrams
- Component diagrams
- Network maps
- Circle/spoke diagrams
- Comparison tables
- Business forms
- Checklists
- 'Target' (bull's eye) diagrams

All of these have a basic 'snap template' into which shapes can be quickly plugged, together with text and links with arrows, etc. In addition, there's a 'Freestyle' template for free-form diagrams, and also a 'Custom' template which allows you to produce your own templates for other frequently needed diagrams and charts.

It's also possible to customise the Shape Palette for any of the templates, by adding in component shapes which have been drawn in a drawing package, or are perhaps taken from clip art.

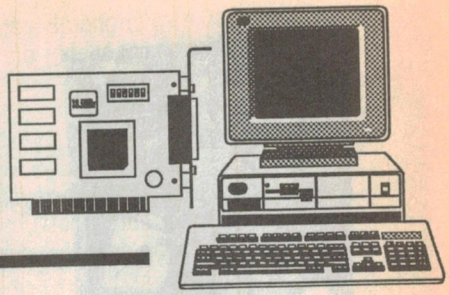
By the way, a very nice feature of *SnapGrafx* is that most of the component shapes available for each template can be given depth, for a '3D' effect. Quite a few depth effects are available, and most are adjustable in degree as well as texture, colour etc.

In short, then, *SnapGrafx* is a very nifty little package and one that makes production of commonly used diagrams, charts and tables very easy and fast. About the only kind of common diagram it *doesn't* seem to provide for, straight away, is a 'pie' chart — in either 2D or 3D form. We found this a little surprising; perhaps the next version will include it...

Otherwise, it should be of great value to anyone who needs to produce simple diagrams and charts, quickly.

The quoted RRP for *Snapgrafx* is $395, and it should be available from most of the larger computer software outlets. It's apparently also available directly from Micrografx Australia, of Level 5, 10 Help Street, Chatswood 2067; phone (02) 415 2642, or fax (02) 415 2641. ❖

Computer News and New Products



Mouse pen

Retailing for $70, the Chic Pen Mouse, developed by Chic Technology, features a sleek, ergonomic design, a dynamic resolution of 240 - 2400dpi (dots per inch) and uses the latest opto-mechanical technology for pinpoint accuracy. The Pen Mouse has been introduced to meet growing consumer demand for mouse devices that are easy to operate and comfortable to use.

Because some people have trouble using a conventional mouse or trackball, the Chic Pen Mouse offers an alternative mouse interface, which is ergonomically designed to nestle easily in the hand. This is not just for aesthetic purposes, but more particularly for user comfort and reduction in wrist-strain.

The pen mouse comes in a serial version, requires no external power, is compatible with the Microsoft Mouse and comes complete with a range of software drivers. It is suitable for left or right handers, and suits all IBM PC and compatible desktop, laptop and notebook computer systems. Easy to install and

operate, it is intended for both the novice and busy PC user.

For further information circle 162 on the reader services coupon or contact Mi-Lyn Imports, 4 Briar Street, Fulham Gardens 5024; phone (08) 235 2388, fax 235 1756.

Fast SCSI host adaptor for EISA

The Adaptec AHA-2742T series of SCSI (small computer system interface) host adaptors significantly increase the data throughput and storage expansion capability of Enhanced Industry Standard Architecture (EISA) workstations and file servers. The Series features a dedicated, performance-enhancing reduced instruction set computing (RISC) processor, and also offers a SCSI host adaptor that doubles — to 14 — the number of peripherals that can be attached to one host adaptor.

Powered by the PhaseEngine, an onboard dedicated RISC processor, the AHA-2742T reduces by up to 90% the time required by the SCSI bus to carry out typical commands. With this reduced overhead time, data is transferred between the EISA systems and SCSI peripherals faster than the industry standard, and increase overall system performance. The adaptor also features Adaptec's integrated TwinChannel design, which provides two independent

Removable hard drive

A new super slim hard disk drive, the Teac-Star, is removable. It comes as a kit consisting of the drive, docking bay for a 5.25" slot and carrying case. With a 3.5" form factor, 12.7mm height and a light weight of only 280g, it has storage capacities of 250MB and 360MB.

Both the 250MB and 360MB models require only a single 5V DC power source and power consumption during read/write operation is only 2.5W, giving a sigificant power saving.

The performance is further enhanced by use of the read-ahead function of the 128KB data buffer. Both drivers are fully compatible with the industry standard IDE interface.

For further information circle 161 on the reader service coupon or contact Southend Data Storage, PO Box 25, Menai 2235; phone (02) 541 1006, fax 543 8093.

SCSI channels to which peripherals can be attached. With two channels, one AHA-2742T can thus attach up to 14 different SCSI peripherals, conserving the limited number of expansion slots in an EISA machine. This feature allows a microcomputer to combine disk arrays, tape back-up, multimedia and archiving capabilities on one host adaptor.

For further information circle 164 on the reader services coupon or contact Anabelle Bits, Unit 7, 5 Dunning Avenue, Rosebery 2018; phone (02) 313 6155, fax 313 6143.

New RF models for Spice

Intusoft has released an update to its popular SPICE model library for RF devices. The new library Version 3.0, is triple the size of the previous version and contains over 200 new models. Several new types have been added, including those for PIN diodes, MMICs, GaAs MESFETs, and an ideal coupler. SPICE models for bipolar transistors, and RF beads round out the rest of the RF library. Over 100 models for BJTs, MMICs, and GaAs MESFETs supplied by Hewlett-Packard and over 95 models for BJTs supplied by Philips, are included in the update. The additions bring the total model library size to well over 300 models. The models can be used with any Berkeley SPICE compatible simulator on any computer platform, including Intusoft's own IsSpice programs.

There are difficulties in creating RF transistor SPICE models, which use the non-linear Gummel-Poon model. However, Intusoft uses special custom software and new optimisation techniques to solve the modeling problems. Unlike some RF SPICE models, its models do not use unrealistic parameters to 'force' fit the device behaviour. Instead a custom subcircuit approach is used to account for all package parasitics and match the published s-parameter magnitude and phase data. These models allow any SPICE program to simulate linear and nonlinear RF circuits using frequency, DC and time domain analyses.

For more information circle 166 on the reader services coupon or contact ME Technologies, PO Box 50, Cyers Crossing 2429; phone (065) 50 2254.

Smart UPS Software

Deltec's PowerCheck Pro shutdown control and monitoring software is a line of power interface software. It offers features which enhance the performance of a UPS, by providing additional power protection on all common network operating systems — including Novell, Lan Manager, Banyan Vines and all Unix-based platforms. Operating as a background utility, it uses very little CPU time and is capable of informing users and network managers of UPS activity, shutdowns and power status.

The two functional parts of the software are its Power Monitoring Capabilities and Control Centre. The power monitor operates in the background, monitoring the UPS information, logging data and alerting users of power failures and shutdowns. The control centre is a user-accessible mode that allows the power monitor to be configured to perform different operations. PowerCheck Pro also provides the user with an Auto shutdown capability, so that in the event of a prolonged power disturbance (such as a power failure) during unattended operation, the UPS will signal the main Server to initiate an orderly shutdown just prior to the UPS running out of battery power. Two versions of the software are available. The **Basic** package is for uninterruptible power systems that have a non-intelligent interface (voltage free contacts), which limits the amount of information available from the UPS; and the second is a **Smart** version, which allows the UPS to communicate with the Network via an intelligent RS232 port on the rear of the UPS.

For further information circle 167 on the reader services coupon or contact Online Control, 29-31 Carlotta Street, Artarmon 2064; phone (02) 436 1313, fax 438 1480.

Advanced Schematic and PCB version 2.0

Protel Technology has released new versions of its Windows-based schematic design and PCB layout systems, which increase the level of automation.

Advanced Schematic 2.0 provides a host of new features to automate schematic drawing. These include guided wiring, find and replace text editing, and global editing across projects. The new release also includes support of EEsof simulation packages; on-line bi-directional cross probing with, and full forward annotation to, Advanced PCB; enhanced support for SPICE and EDIF netlists; and a new font management system.

Concurrent with this release is that of the 32-bit, Advanced PCB version 2.0. The new version includes the full forward annotation to communicate with Schematic 2.0, as well as direct loading of PADS 2000 PCB files, padstack support, pick & place output and full editable copper pours with arcs. Its overall resolution is one millionth of an inch.

For more information circle 168 on the reader services coupon or contact Protel Technology, GPO Box 204, Hobart 7001; phone (002) 73 0100.

Extended storage for 3.5" drives

Maxtor Australia has announced two additions to its 3.5" high-capacity disk drives: the Maxtor 7546, a two-disk 546MB drive for use in high end PCs and entry-level workstations, which is now the highest capacity drive in the 3.5" 7000 Series; and the single disk 7273, with a formatted capacity of 273MB, which offers improved value over existing drives for mid-range desktop systems.

The 7546 and 7273 both feature a typical 12ms average seek time, with a track-to-track seek time of only 2ms and an increased rotational speed of 4500rpm. The drives support a 256KB multi-segmented cache and a high performance ATA interface for local bus applications. These features enable both multi-word direct memory addressing (DMA) Mode 1 rates of up to 11.1MB per second.

The drives also support logical block addressing and intended cylinder addressing, both of which enable capacities beyond the traditional 528MB limit, and the Read/Write Multiple feature, which

allows higher performance on sequential transfer.The ultra low power modes provide as little as 0.7W during sleep mode, essential for the emerging Energy Star ('green machine') desktop designs.

Both drives feature MaxCache, a performance-enhanced write cache algorithm that significantly improves write throughput by eliminating the traditional latency associated with sequential write commands. Other enhancements provided by MaxCache include separate read and write buffer management for optimising performance to the current applications.

For more information circle 171 on the reader services coupon or contact Maxtor Disk Drives, Suite 103, 55 Grafton Street, Bondi Junction 2022; phone (02) 369 3662, fax 369 2082.

Designer 4.0

Micrografx has released in Australia its latest version of the Designer drawing program for technical illustrators, professional designers and graphics artists. Its major enhancement is in the use of a 32-bit computing engine.

By being able to use 32-bit numbers, Designer 4.0 can now deal with a page size of more than a kilometre with an accuracy of 25,400dpi! (Older 16-bit software is restricted to pages of 1.73m at 480dpi.)

For further information circle 165 on the reader services coupon or contact Micrografx Australia, Level 5, 10 Help Street, Chatswood 2067; phone (02) 415 2642, fax 415 2641.

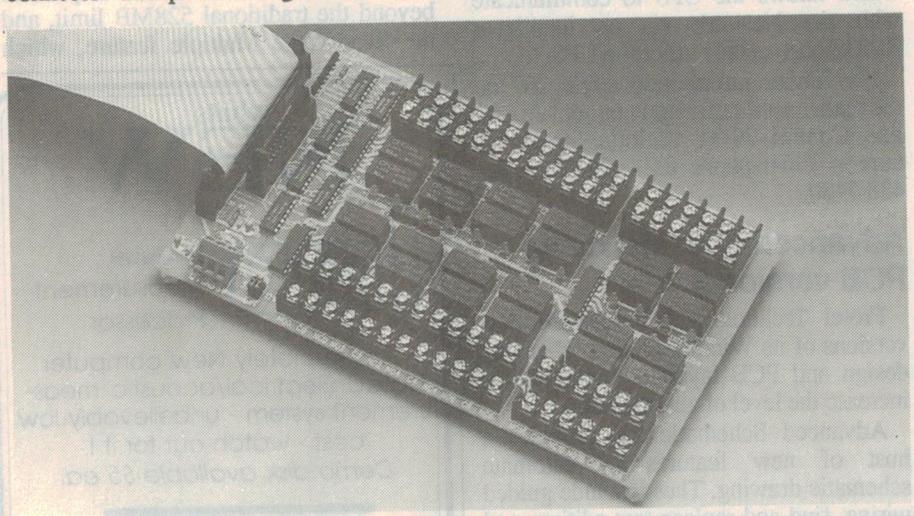
Relay module

The Advantech PCLD-785B is claimed as a breakthrough in cost per channel for relay output applications.

It offers either 24 or 16 SPDT electromechanical relays. An opto-22 compatible 50-pin connector accesses all 24 channels. A 20-pin flat cable connector (compatible with the digital outputs of most Advantech PC-LabCards) accesses 16 channels. The board automatically switches control logic to match the connector — negative logic for the 50-pin connector and positive logic for the 20-pin connector. Each relay has three contacts: common, normally open and normally closed. Convenient screw-connector strips on the card sides make wiring easy.

A red LED next to each relay indicates its ON/OFF status. The PCLD-785B is an economical solution for applications which control a large number of outputs, such as signal switching, ON/OFF control, alarm activation and test automation.

For further information circle 180 on the reader service card or contact Priority Electronics, 23-25 Melrose Street, Sandringham 3191; phone (03) 521 0266.



HPGL plotter emulation software

Insight Development, the maker of *PrintAPlot* has released a new version of its HPGL plotter emulation software which turns printers into high performance personal plotters. *PrintAPlot* 3.04, with over 1200 graphics printer drivers, supports over 1200 laser, ink jet, PostScript and dot matrix printers at resolutions from 75 to 600dpi, and allows users to print continuous-paper long plots (where applicable).

The software includes support for 255 pens — with any pen able to select from a palette of 255 AutoCAD or Insight colours. Users can change pen or line widths, patterns and colours, tile 'A' to 'E' size drawings, adjust plot scaling or rotation, and batch print to a standalone or to a Novell NetWare queue. *PrintAPlot* also supports multiple paper sizes and requires no additional memory. It works with AutoCAD, MicroStation, CADKEY and all other CAD graphics software applications. Users can pop-up *PrintAPlot* over their application as a TSR, run it in DOS under Windows, or as a standalone application. Its RRP is $270.

For more information circle 170 on the reader services coupon or contact Technical Imports Australia, PO Box 120, Castle Hill 2154; phone (02) 894 6377, fax 894 6102. ❖

AMPLIFIERS

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LM11CLH	Precision DC Amp	$7.15
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TL074CN	Quad JFET Amplifier	$1.50
TL081CN	Sngl JFET Amplifier	$1.15
TL082CN	Dual BIFET	$1.70
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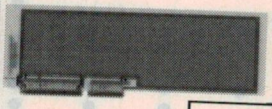

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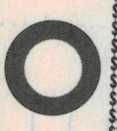
FER-T-200-(2)	Toroid 2.000 OD 1.25 ID	$20.00
FER-T-200A-(2)	Toroid 2.000 OD 1.25 ID	$28.60



Send a stamped self addressed envelope for data

Hardware

Matrix Pins

MATRIX-PINS/50	Matrix Pins x 50	$3.00
MATRIX-PINS/1000	Matrix Pins x 1000	$34.95

Nuts

NUT-H3175	3mm Hex Nut x 25	$2.55
NUT-H3177	3mm Hex Nut x 200	$5.35
NUT-H3380	4mm Hex Nut x 25	$2.95
NUT-H3382	4mm Hex Nut x 200	$6.20

Screws

SCREW-H1100	No.4x6mm Tapper x 25	$2.40
SCREW-H1112	No.4x12mm Tapper x 200	$7.85
SCREW-H1116	No.6x9mm Tapper x 25	$2.65
SCREW-H1117	No.6x9mm Tapper x 200	$7.80
SCREW-H1120	No.8x12mm Tapper x 25	$2.70
SCREW-H1122	No.8x12mm Tapper x 200	$7.95
SCREW-H1130	No.6x9mm Tapper x 25	$2.85
SCREW-H1132	No.6x9mm Tapper x 200	$9.25
SCREW-H1139	No.4x9mm Tapper x 25	$2.10
SCREW-H1140	No.4x9mm Tapper x 200	$5.20
SCREW-H3110	3x6mm Screw x 25	$2.45
SCREW-H3115	3x25mm RH Screw x 200	$4.65
SCREW-H3125	3x10mm RH Screw x 200	$4.95
SCREW-H3120	3x10mm Screw x 25	$2.50
SCREW-H3130	3x15mm Screw x 25	$2.60
SCREW-H3135	3x15mm RH Screw x 200	$5.60
SCREW-H3140	3x20mm Screw x 25	$2.65
SCREW-H3145	3x20mm RH Screw x 200	$6.25
SCREW-H3146	3x20mm RH Scrw x 1000	$15.95
SCREW-H3150	3x25mm Screw x 25	$2.80
SCREW-H3155	3x25mm RH Screw x 200	$7.40
SCREW-H3160	3x25mm Screw x 25	$3.60
SCREW-H3165	3x32mm Screw x 200	$10.50
SCREW-H3310	4x10mm Screw x 25	$2.75
SCREW-H3315	4x10mm RH Screw x 200	$7.20
SCREW-H3320	4x15mm Screw x 25	$2.90
SCREW-H3325	4x15mm RH Screw x 200	$7.80

Spacers

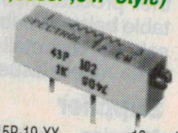
SPCR-H1320	5x12mm Nylon x 10	$3.00
SPCR-H1323	5x15mm Nylon x 10	$3.20
SPCR-H1324	5x15mm Nylon x 100	$10.50
SPCR-H1327	5x20mm Nylon x 100	$11.25
SPCR-H1355	3x6mm Untapped x 8	$2.45
SPCR-H1359	3x6mm Untapped x 100	$9.90
SPCR-H1362	3x9mm Untapped x 8	$2.60
SPCR-H1365	3x9mm Untapped x 100	$11.75
SPCR-H1372	3x12mm Untapped x 8	$2.85
SPCR-H1373	3x12mm Untapped x 100	$14.30
SPCR-H1375	3x25mm Untapped x 8	$2.95
SPCR-H1376	3x25mm Untapped x 100	$24.50
SPCR-H1390	3x10mm Tapped x 8	$3.25
SPCR-H1391	3x10mm Tapped x 100	$19.40
SPCR-H1393	3x15mm Tapped x 8	$3.70
SPCR-H1394	3x15mm Tapped x 100	$24.80
SPCR-H1396	3x25mm Tapped x 8	$5.00
SPCR-H1397	3x25mm Tapped x 100	$41.20

Washers

WASHER-H3180	3mm Flat Washers x 25	$1.35
WASHER-H3182	3mm Flat Washer x 200	$4.65
WASHER-H3185	3mm Shakeproof x 25	$2.70
WASHER-H3187	3mm Shakeproof x 200	$6.65
WASHER-H3385	4mm Flat Washer x 25	$1.70
WASHER-H3387	4mm Flat Washer x 200	$5.35
WASHER-H3389	4mm Shakeproof x 25	$2.95

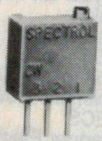
Multi-Turn Trim Pots

End Adjust Multi Turn (43P,3006P,94P Style)



POT-15P-19-XX 19mm 15 Turn
XX= Value 100, 200, 500Ω 1, 2, 5, 10, 20, 25, 50, 100, 200, 500kΩ 1M **$1.40**

Top Adjust Multi Turn (64W,3296W Style)



POT-25W-TA-XX 10mm 25 Turn TA
XX= Value 50, 100, 200, 500Ω 1, 2, 5, 10, 20, 50, 100, 200, 500kΩ 1, 2M **$2.30**

Side Adjust Multi Turn (64X, 3296X Style)

POT-25X-SA-XX 10mm 25 Turn SA
XX= Value 100, 200, 500Ω 1, 2, 5, 10, 20, 50, 100, 200, 500kΩ 1, 2M **$2.30**

Pot Adjuster

POT-ADJUSTER Trimmer Driver w/clip **$4.10**

Vertical Mount Single Turn

POT-ST06-SA-XX 6mm Single Turn
XX= Value 100, 200, 300Ω 1, 2, 3, 5, 10, 20, 30, 50, 100, 200, 300kΩ 1M **$0.55**

Horizontal Mount Single Turn

POT-ST06-TA-XX 6mm Single Turn
XX= Value 100, 200, 300Ω 1, 2, 3, 5, 10, 20, 30, 50, 100, 200, 500kΩ 2M **$0.55**

Turns Counting Dials

DIAL-25MM-15T 25mm 15 Turn Dial **$23.10**

DIAL-45MM-15T 45mm 15 Turn Dial **$42.75**

10 Turn Panel Mount Pots

POT-10T-22-XX 10 Turn 7/8 Pot,
XX= Value 100, 500Ω 1, 2, 5, 10, 20, 50, 100kΩ **$25.10**

NEW Electrowipes

These lint-free cloths come impregnated with electronic grade solvents for cleaning edge connectors, switch contacts etc. They are individually packed in sachet form for perfect cleanliness every time. Solvents evaporate to leave a clean dry surface. Three types, 10 sachets per pack :

IPA Isopropylalcohol solvent for switches and edge connectors etc Flammable **$7.50**

Gold contact lubricant improves conductivity and increases lifetime dramatically **$12.50**

ECS Electronic cleaning solvent non-toxic, non-flammable for delicate components, will not harm surrounding plastic parts **$12.50**

8.30am to 5.00pm Mon to Fri. 8.00am to 12 noon Saturday.
Mail Orders add $5.00 min to cover postal charges.
Next day delivery in Sydney add $8.00.
All prices include Sales tax unless stated otherwise.
Tax exemption certificates accepted if the line value exceeds $10.00.
BANKCARD, MASTERCARD, VISA, CHEQUES or CASH cheerfully accepted.

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(inc in N S W)

229 Burns Bay Road, Lane Cove West
N S W 2066 (Corner Beatrice Street)

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EA DIRECTORY OF SUPPLIERS

Which of our many advertisers are most likely to be able to sell you that special component, instrument, kit or tool? It's not always easy to decide, because they can't advertise all of their product lines each month. Also some are wholesalers and don't sell to the public. The table below is published as a special service to EA readers, as a guide to the main products sold by our retail advertisers. For address information see the advertisements in this or other recent issues.

Supplier	State	A	B	C	D	E	F	G
Altronics	WA	●	●	●	●	●	●	●
Companion Computers	VIC		●					
Dick Smith Electronics	ALL	●	●	●	●	●	●	●
Emona Instruments	NSW						●	
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Scientific Devices	VIC						●	
TECS	VIC	●	●	●	●	●	●	●
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KEY TO CODING:

A Kits and modules
B Tools
C PC boards and supplies
D Components
E IC chips and semiconductors
F Test and measuring instruments
G Reference books

Note that the above list is based on our understanding of the products sold by the firms concerned. If there are any errors or omissions, please let us know.

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PCB PATTERNS: High contrast, actual size transparencies for PCBs and front panels are available. Price is $5 for boards up to 100sq.cm, $10 for larger boards. Please specify negatives or positives.

PROJECT QUERIES: Advice on projects is limited to postal correspondence only and to projects less than five years old. Price $7.50. Please note that we cannot undertake special research or advise on project modifications.

Members of our technical staff are not available to discuss technical problems by telephone.

OTHER QUERIES: Technical queries outside the scope of 'Replies by Post', or submitted without fee, may be answered in the 'Information Centre' pages at the discretion of the Editor.

PAYMENT: Must be negotiable in Australia and payable to 'Electronics Australia'. Send cheque, money order or credit card number (American Express, Bankcard, Mastercard or Visa card), name and address (see form).

ADDRESS: Send all correspondence to: The Secretary, Electronics Australia, P.O. Box 199, Alexandria, NSW 2015; phone (02) 353 0620.

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DC MOTORS

We have good stocks of 2 large high quality Japanese DC motors. These should suit many industrial, hobby, robotics and other applications.

M9 — 12V, I No load = 0.52A — 15,800 RPM at 12V, main body 36mm Diam. — 67mm long

$9

M14 — Made for slot cars, 4-8V, I No load = 0.84A at 6V, at max efficiency I = 5.7A — 7500 RPM, main body 30mm Diam. — 57mm long

$10

DIGITAL VOICE RECORDER KIT

Includes PCB, all on-board components, switches, pushbuttons, a speaker and a battery holder. That's everything you need to make a digital voice recorder with a variable recording time of 5-16 seconds. Construction is simplified because the main control IC is pre-assembled on the PCB. Full information provided with this great kit.

$30

CCD ELEMENT

BRAND NEW high sensivitity monolythic single line 2048 element image sensors as used in fax machines, optical character recognition and other high resolution imaging applications. Fairchild CCD122. Have usable response in the visible and IR spectrum. Supplied with 21 pages of data and a typical application circuit.

$30

SOME DIFFERENT COMPONENTS

1000pF/15KV Disc ceramic capacitors

$5

10KV PIV-5mA Fast diodes

$1.50

0.01uF/5KV Disc ceramic capacitors

$1.80

680pF/3KV Disc ceramic capacitors

30c ea.

Flexible Decimal Keypads with PCB connectors to suit

$1.50

Schottky Barrier diodes 30V PIV-1A/25A Pk.

45c

SGS P222 "N" channel 50V-10A Mosfets

10 for $8

Thompson TGAL606 60A/600V Triacs

$10 ea.

LASER LIGHT SHOW

Finally an affordable Laser Scanner that can draw stars, circles, squares and even text! The complete kit includes two galvos, computer interface, manual, and the software. Works from a parallel printer port. Incredible introductory price:

$350

MINIATURE FM TRANSMITTER

Not a kit, but a very small ready made self contained FM transmitter enclosed in a small black metal case. It is powered by a single small 1.5V silver oxide battery, and has an inbuilt electret microphone. SPECIFICATIONS: Tuning range: 88-108MHz, Antenna: Wire antenna-attached, Microphone: Electret condenser, Battery: One 1.5V silver oxide LR44/G13, Battery life: 60 hours, Weight: 15g, Dimensions: 1.3" X 0.9" X 0.4". Some would call this a miniature "BUG" and sell it for much more than our price:

$32

MINI EL-CHEAPO LASER

A very small kit inverter that employs a switch mode power supply. Very efficient! Will power a 1mW tube with a 12V battery whilst consuming about 600mA! Excellent for high brightness laser sights, laser pointers etc. Comes with a compact 1mW laser tube with a maximum dimension of 25mm diameter and an overall length of 150mm. The power supply will have overall dimensions of 40 x 40 x 140mm, making for a very compact combination.

$69

For a used 1mW tube plus the kit inverter.

It is hard to exhaust a laser tube! All our tubes are guaranteed for six months. If you want to purchase a spare second tube with the above combination (two tubes plus one supply) just add $25 to the price. Two used 1mW tubes plus one "Mini el-cheapo laser" for a total of $94. This offer applies to initial purchase only: specify when ordering.

PASSIVE NIGHT VIEWER

This is a completed commercial monocular hand held night viewer, that employs an image intensifier tube: Luminous gain of 12500! The viewer is of a USSR military standard, and will produce useful images in as little as starlight illumination. Has adjustable low light objective lens, adjustable eyepiece, and is supplied with a carry case. Limited supplies at an incredible price of:

$499

SOLAR PANELS

Brand new 6 volt 1 watt amaphourous solar panels, 150m X 150mm will deliver one watt whilst charging 6-8V batteries. Two of these in series make a great 12V battery maintainer/charger. Terminating clips are provided, but weather proofing of the rear is necessary. Instructions provided. INCREDIBLE REDUCED PRICES:

$11 ea

4 for $40; 10 for $80

12V solar regulator and charge indicator PCB and components kit — $8.

12V OPERATED LASER

This combination includes one used 3mW SIEMENS laser tube and one 12V Universal Laser power supply MKIII kit. The inverter is easy to construct since it is supplied with a prewound transformer, and it will power He-Ne laser tubes with a power rating in the 0.5-15mW range.

$99

For one 3mW tube plus a 12V Universal laser inverter kit.

LASER DIODE KIT — 5mW-670nM

Our best visible laser diode kit ever! This one is supplied with a 5mW-670nM diode and the lens already mounted in a small brass assembly, which has the three connecting wires attached. The lens used is the most efficient we have seen, and its focus can be adjusted. We also provide a PCB and all onboard components kit for a driver kit that features Automatic Power Control (APC). Head has a diameter of 11mm and is 22mm long, APC driver PCB is 20 x 23mm, 4.5-12V operation at approx 80mA.

$99

Note that because of the human eye response at this wavelength the intensity of the beam generated compares to a 0.8mW He-Ne tube.

PRECISION STEPPER MOTOR

This precision 4 wire Japanese stepper motor has 1.8 degree steps: That is 200 steps per revolution! 56mm diameter, 40mm high, drive shaft has a diameter of 6mm and is 20mm long, 7.2V-0.6A DC. We have a good, but LIMITED supply of these brand new motors:

$20

IR VIEWER "TANK SET"

ON SPECIAL is a set of components that can be used to make a complete first generation Infra Red night viewer. These matching lenses tubes and eyepieces were removed from working tank viewers, and we also supply a suitable EHT power supply for the particular tube supplied. This power supply may be ready made or in kit form: Basic instructions provided. The resultant viewer requires IR illumination.

$180

We can also supply the complete monocular "Tank viewer" for the same price, or a binocular viewer for $280. "Ring"

FM MICROPHONE

Features a stainless steel case and a UNIDIRECTIONAL microphone insert, powered by two "AA" batteries. High quality at:

$35

INDUCTIVE PROXIMITY SWITCHES

These industrial quality detectors will detect ferrous and non-ferrous metals at close proximity. Some are DC powered (10-30V), some are mains AC powered, and all will switch loads directly. All have three wires for connecting into circuitry: Two for the supply, and one for switching the load. These also make excellent sensors for rotating shafts etc. LIMITED SUPPLIES. ON SPECIAL AT:

$22 ea.

or 6 for $100

GREEN LASER TUBES

We have a limited supply of some 0.5mW GREEN (560nM) He-Ne laser tubes. Because of the relative response of the human eye these appear as bright as about a 2mW red tube: very bright. We will supply this tube and a suitable 12V laser power supply kit for a low:

$299

MASTHEAD AMPLIFIER KIT

Based on an IC with 20dB of gain, a bandwidth of 2GHz, and a noise figure of 2.8dB, this amplifier kit outperforms most other similar IC's and is priced at a fraction of their cost. The cost of the complete kit of parts for the masthead amplifier PCB and components and the power and signal combiner PCB and components is PRICED AT AN INCREDIBLE:

$20

For more information see a novel and extremely popular antenna design which employs this amplifier: MIRACLE TV ANTENNA — E.A. May 1992. Box, Balun, and tinplate for antenna (slightly different design): $5 extra. Plugpack $12.

PASSIVE NIGHT VIEWER BARGAIN

This kit is based on a BRAND NEW passive night vision scope, which is completely assembled and has an EHT coaxial cable connected. This assembly employs a high gain passive tube which is made in Russia. It has a very high luminous gain, and the resultant viewer will produce useful pictures in sub-moonlight illumination. The viewer can also be assisted with infra red illumination in more difficult situations. It needs an EHT power supply to make it functional, and we supply a suitable supply and its casing in kit form. This would probably represent the best value passive night viewer that we ever offered! BECAUSE OF A SPECIAL PURCHASE OF THE RUSSIAN SCOPES WE HAVE REDUCED THE PRICE OF THIS PREVIOUSLY ADVERTISED ITEM FROM $550 TO A RIDICULOUS:

$399

This combination will be soon published as a project in E.A. NOTE THE REDUCED PRICE: LIMITED SUPPLY.

HIGH INTENSITY LED's

Narrow angle 5mm red LED's in a clear housing. Have a luminous power output of 550-1000mCD @ 20mA: That's about 1000 times brighter than normal red LED's.

SPECIAL REDUCED PRICE:

50c ea.

or 10 for $4

or 100 for $30

ALUMINIUM TORCHES — INFRA RED LIGHTS

These are high quality heavy duty black anodised aluminium torches that are powered by four "D" cells. Their focussing is adjustable from a spot to a flood. They are water resistant and shock proof. Powered by a krypton bulb. Spare bulb included in cap.

$42

Note that we have available a very high quality INFRA RED FILTER and a RUBBER lens cover that would convert this torch to a good source of IR: $15 extra for the pair.

LIGHT MOTION DETECTORS

Small PCB Assembly based on a ULN2232 IC. This device has a built in light detector, filters, timer, narrow angle lens, and even a siren driver circuit that can drive an external speaker. Will detect humans crossing a narrow corridor at distances up to 3 metres. Much higher ranges are possible if the detector is illuminated by a remote visible or IR light source. Can be used at very low light levels, and even in total darkness: With IR LED. Full information provided. The IC only, is worth $16! OUR PRICE FOR THE ASSEMBLY IS:

$7 ea. or 5 for $30

INFRA RED TUBE AND SUPPLY

These are the key components needed for making an INFRA RED NIGHT VIEWER. The tubes will convert infra red light into visible light on the phosphur screen. These are prefocussed tubes similar to type 6929: Do not require a focus voltage. Very small: 34mm diameter, 68mm long. All that is needed to make the tube operational is a low current EHT power supply, which we provide ready made or in kit form: powered by a 9V battery and typically draws 20mA. INCREDIBLE PRICING:

$90

For the image converter tube and an EHT power supply kit! All that is needed to make a complete IR night viewer is a lens, an eyepiece and a case. See E.A. May and Sept. 1990.

24V DC TO MAINS VOLTAGE INVERTERS

In the form of UNINTERRUPTABLE POWER SUPPLIES (UPSs). These units contain a 300W, 24V DC to 240V-50HZ mains inverter. Can be used in solar power systems, etc., or their original intended purpose of UPSs. THESE ARE VERY COMPACT, HIGH QUALITY UPSs. They feature a 300W-450W (50HZ) SINE WAVE INVERTER. The inverter is powered by two series 12V-6.5AHr (24V) batteries that are built into the unit. There is only one catch: Because these NEW units have been in storage for a while, we cannot guarantee the two batteries for any period of time, but we will guarantee that the batteries will perform in the UPSs when these are supplied. We will provide a three month warranty on the UPSs, but not the batteries. A circuit will also be provided.

PRICED AT A FRACTION OF THEIR REAL VALUE: BE QUICK!

LIMITED STOCK!

$239

DYNAMIC MICROPHONE

Stage quality Unidirectional (Cardioid) 600ohm dynamic microphone in a black metal housing. Has ON-OFF switch and cannon connector. Prewired lead and clip provided.

$45

OATLEY ELECTRONICS

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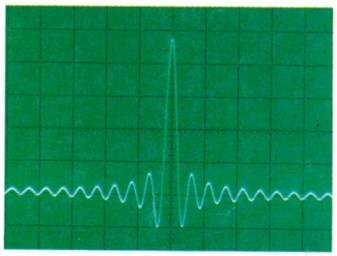
MAJOR CARDS ACCEPTED WITH PHONE AND FAX ORDERS

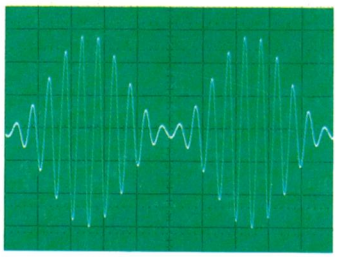
P & P ANYWHERE IN AUSTRALIA

FOR MOST MIXED ORDERS: $2.50-$10

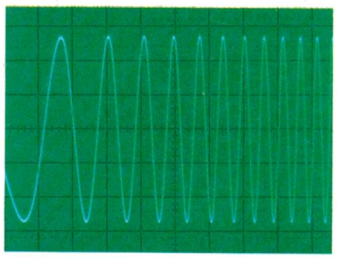
There are many areas where our function generator will surpass your expectations.



A built-in 12-bit, 40 MSample/sec, 16K deep arbitrary waveform generator easily handles your custom waveform needs.

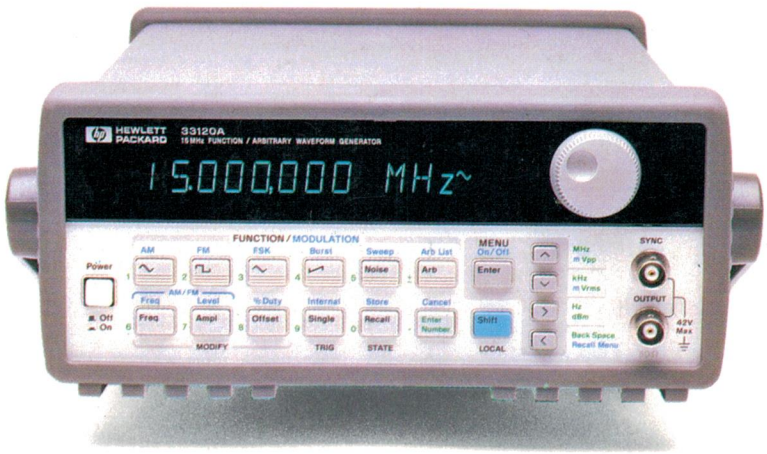


Internal AM, FM, FSK and burst modulation eliminate your need for a second modulation source.



Both linear and log sweeps are built in, making filter and amplifier testing quick and easy.

At a price that falls below them.



The HP 33120A 15 MHz synthesised function/arb generator: Within budget, without compromise.

In the world of function generators, price and performance have always been synonymous. So it's understandable you'd expect to pay more for the measure of confidence you get with a synthesised signal source that delivers stable, accurate signals test after test. Or, for the flexibility to generate complex waveforms with arbitrary waveform capability.

You'd probably also expect to pay a premium for the convenience of built-in sweep and modulation functions. And to have both HP-IB and RS-232 interfaces standard.

Fact is, you can always get high performance with the high price to match. Or, order the HP 33120A fully loaded function/arb generator and get something totally unexpected. A price you can afford.

Call HP to see how much function generator you can get for your money.

Discover just how easy it is to afford a fully loaded 15 MHz function/arb generator with synthesised signal source and arbitrary waveform capability. Once you hear the price, we think you'll agree it's the best deal of any function generator in its class.

In fact, you can learn more about the HP 33120A function/arb generator's custom waveform capability, signal accuracy, easy programmability and any other specifications you may need to make the right decision.

So call our Customer Information Centre on **13 1347** (Australia wide) and ask for extension **2902.**

A better way.

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